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Sound Tracks on Kodachrome

Densitometry of Sulfide Tracks

Reducing Film Buckle

Direct-Positive Variable-Density Recording

Interlingua

Binaural Recorder

Focus Device and Blimp

Theater Television System

Theater Television Progress

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Optimum Exposure of Sound Tracks on Kodachrome Films

By ROBERT C. LOVICK

Low-distortion sound tracks on Kodachrome films can be obtained with any conventional exposure method. The best possible sound reproduction requires exposure with light of color quality which correlates the speeds of the individual emulsions when developed to silver sulfide rather than to dyes. Poor sound quality in the past has often been the result of the failure to recognize the critical color quality requirement of the light which exposes the sound-track portion of the film.

KODACHROME Duplicating Color Film, Type 5265 is a 16mm, reversal film designed to be printed from color positives on Kodachrome Films, Daylight Type (5263), Type A (5264), and Kodachrome Commercial Film (5268). The sound-track deposit is silver sulfide. The sound-track record is printed from silver positives prepared according to long-standing recommendations.

The sound process for Kodachrome films consists of three basic steps. First, the silver halides which were exposed in the sound-track printer are developed to a silver negative image. Second, the silver halide which remains is converted to silver sulfide. Third, the negative silver is dissolved, leaving a reversal silver sulfide image.

There are many complicating factors in this basically simple process. For example, the necessity of confining the sound developer to the sound-track area within small tolerances precludes the use of agitation to aid in securing uniform development.

Recent studies have shown that a large part of the stain level of Kodachrome sound records results from conversion of some of the negative silver to silver sulfide. A modified developer which converts a much smaller part of the negative silver to silver sulfide is now being used. There is a small improvement of signal-to-noise ratio which is the result of the increased useful transmission range. The sensitometric effect of the sound developer modification is shown in Fig. 1.

Standardized Printing Methods

Printing to obtain the best possible sound tracks on Kodachrome films requires consideration of three facts. First, the exposures are made on a multilayer film. Second, the three emulsion

Presented on April 24, 1952, at the Society's Convention at Chicago, Ill., by Robert C. Lovick, Color Control Div., Eastman Kodak Co., Rochester 4, N. Y.

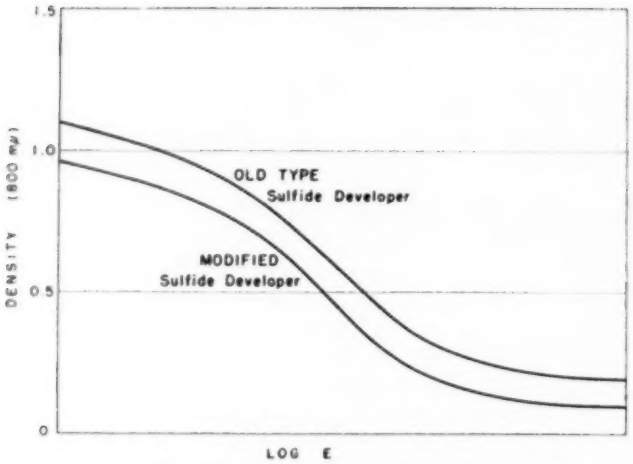

Fig. 1. Sensitometric effect of modified silver sulfide developer.

layers are sensitized to respond principally to three different colors of light. Third, the speed relationships of the layers are determined by the characteristics desired for the dye formation for pictures while sound-track development converts the halides in all layers to silver sulfide, a much different material.

Sound tracks on Kodachrome films are usually printed using a conventional sound printer with adjustments of the printer lamp current to obtain a particular density. Changing the printer lamp current results in the simultaneous change of both the intensity and the color quality of the light source. Since the efficiency of different optical systems varies considerably, and since many different types of lamps and heat absorbers are in use, it is almost impossible to give any information, such as a filter balance, which can be applied without further extensive tests on the particular equipment involved.

Standardizing the light source for sound-track printing requires very little additional control work for most laboratories and makes possible the use of printing recommendations without extensive tests. If conventional distortion tests can be made, there is still a considerable saving of time and film because an excellent starting place is available for adjusting the exposure balance for particular equipment. Should emulsion changes become necessary or desirable, the extent of filter-pack modification could be specified, reducing appreciably the need of additional time- and film-consuming tests.

A fixed color temperature of 2900 K for a tungsten source is suggested because it is well within the rating of most lamps and because experience has indicated that more than enough light is available on almost any printer. Heat-absorbing glasses may greatly modify the spectral energy distribution of the light source. Heat-absorbing glasses should be Pittsburgh 2043, 2 mm thick or an equivalent filter. Adjustments of intensity are made by neutral density filters or diaphragms or both, depending on the particular printer. The final adjustment of color quality is made with Kodak Color Compensating Filters, but

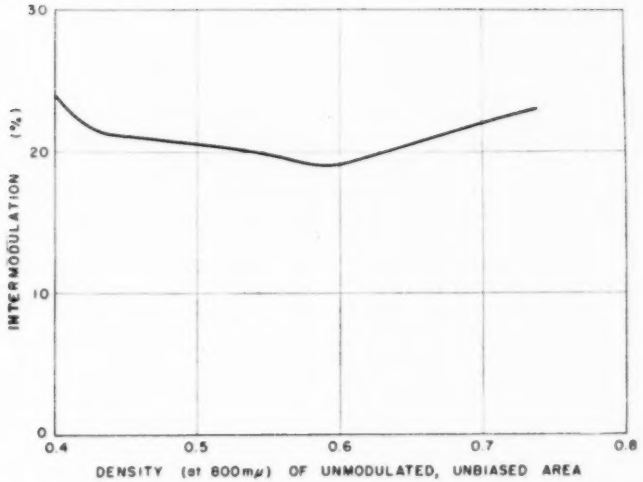

Fig. 2. Intermodulation. Unfiltered light of 2900 K tungsten source.

these filters are not part of the standard source.

Kodak Color Compensating Filters are gelatin filters and should be protected from heat as much as possible. Heat-absorbing glasses should be between the light source and the filters and physically separated as much as possible. Additional air-cooling of the filters is desirable and may be absolutely required in some printers.

The color compensating filters are a necessary part of the filter pack for printing sound on Kodachrome films. The capabilities of printed Kodachrome film for sound reproduction are much better than previous investigators[1,2] have reported, primarily because so little attention was paid to the color quality of the light used in exposing the sound track. The color quality must coordinate the speeds of the three layers or the best sound quality will not be obtained.

Determination of Exposure Conditions for Optimum Sound Quality

Distortion of variable-density prints was determined by the intermodulation method[3] using conditions prescribed by American Standard Z22.51. The negatives employed were sensitometrically normal negatives suitable for printing on black-and-white release positive film. A negative on Eastman Fine Grain Sound Recording Film, Type 5373 was exposed and processed for a gamma of 0.55 and density of 0.55. This negative was printed on Eastman Fine Grain Release Positive Film, Type 7302 and processed to a density of 0.55 and gamma of 2.50.

Variable-area distortion was determined by the cross-modulation test[4] with conditions prescribed by American Standard Z22.52. This standard designates a 4000-cycle carrier frequency amplitude-modulated at 400 cycles/sec. The negatives used were prepared on Eastman Fine Grain Sound Recording Film, Type 5372, with a gamma of 3.65 and total diffuse visual density of 2.98. The negatives were printed onto Eastman Fine Grain Release Positive Film, Type 7302 to a gamma of 2.48 and density of 2.0.

A Western Electric RA-1100B Densitometer was used for all density measure-

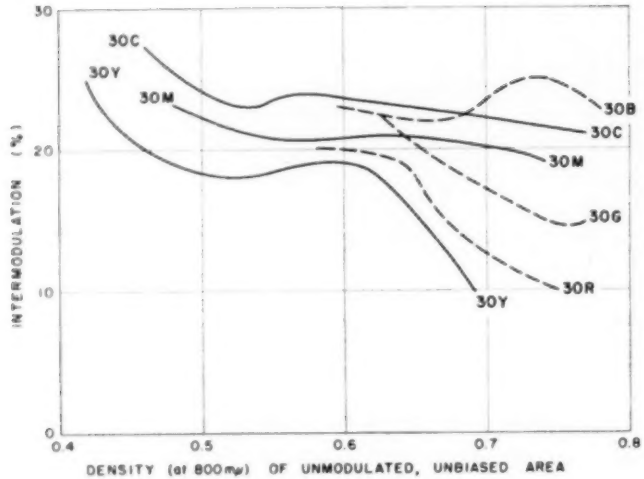

Fig. 3. Intermodulation. Filtered light of 2900 K tungsten source.

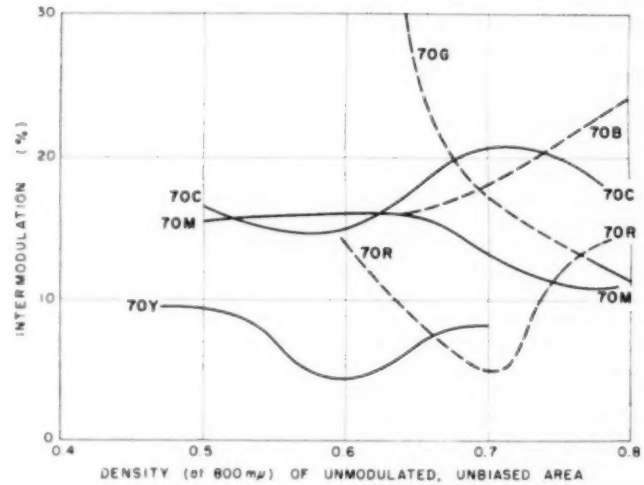

Fig. 4. Intermodulation. Filtered light of 2900 K tungsten source using stronger filters in the printing beam than shown in Fig. 3.

ments. A visual sensitivity characteristic was used for all black-and-white materials. The instrument was converted to provide diffuse density measurements at 800 mμ for densitometry of the silver sulfide deposit on the Kodachrome films.[5]

Low-distortion sound records on Kodachrome films can be obtained with any conventional exposure method. The quality of sound reproduction which can be obtained is controlled by the color quality of the light which exposes the film in the sound printer.

The intermodulation curve shown in Fig. 2 was obtained by measurements of Kodachrome Duplicating Color Film, Type 5265. This curve resulted from exposure with the standard light source previously mentioned but without additional color-compensating filters. The only variable in this exposure was the intensity of the printing light. A common error has been to assume, after obtaining such a curve, that this represents the best that could be expected from printed sound tracks on Kodachrome film.

The series of intermodulation curves in Fig. 3 were obtained from measurements of Kodachrome film which had been exposed to different color qualities of light. The curve marked 30Y shows per cent intermodulation for film exposed to the standard 2900 K source with a CC-30 Yellow filter in the printing beam. Intensity changes were made with carbon-deposit, neutral-density filters.

The intermodulation curves shown in Fig. 4 were obtained from measurements of film which had been exposed using stronger filters in the printing beam. The curve obtained by printing with the standard source plus Kodak Color Compensating Filters equal to CC-70 Yellow resulted in an intermodulation level of 4%. This low level of distortion was obtained at a density at 800 mμ of 0.6 (diffuse visual density of 1.4). This is the same density for which the minimum in Fig. 2 was 19%.

One of the most important facts to remember in judging sound-track quality is that density has no significance whatever unless the color quality of the exposing light is rigidly specified. Examination of Figs. 2, 3 and 4 clearly indicates that merely obtaining a particular density on the Kodachrome film does not guarantee quality.

The effects of small variations of color quality are shown in Fig. 5. The curve marked 70Y + 20Y shows per cent intermodulation for film exposed to the 2900 K tungsten source with filters equal to CC-90 Yellow. The series of color balances indicates that the color quality is reasonably critical and also that the low distortion is not the result of confinement of the image to any one layer.

The choice of an optimum balance for variable-area track is less obvious because the cross-modulation product is at least 40 db below the 400-cycle reference level for a considerable range of color balances. Additional considerations governing the choice of color balance for exposing variable-area records are volume level, signal-to-noise ratio, frequency response, and exposure latitude. The cross-modulation curves of Fig. 6 show that the best color balance for variable density, obtained with a CC-70Y filter in the printing beam, is not the most desirable balance for the exposure of variable-area records. In this case the CC-30M balance provides low distortion with the highest usable volume level. Again, density alone is not an indication that the film has been properly exposed.

Conclusions

The color quality of the light which exposes the film in the sound-track printer controls the potential quality of sound reproduction which may be obtained from Kodachrome sound tracks. Density alone is not sufficient to guarantee that the color film has been properly

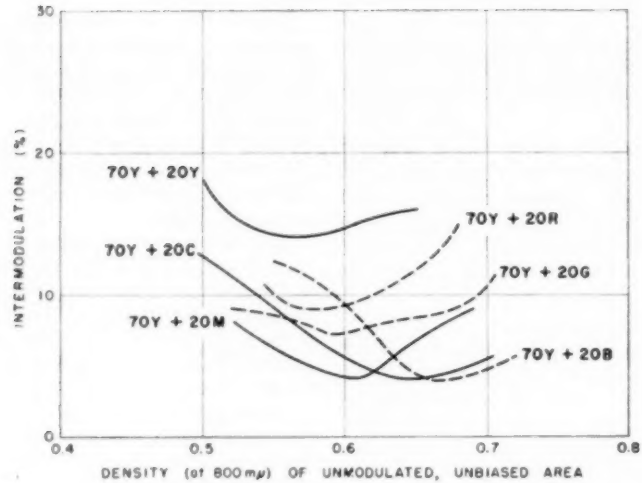

Fig. 5. Intermodulation. Effects of small filter changes from optimum variable-density balance.

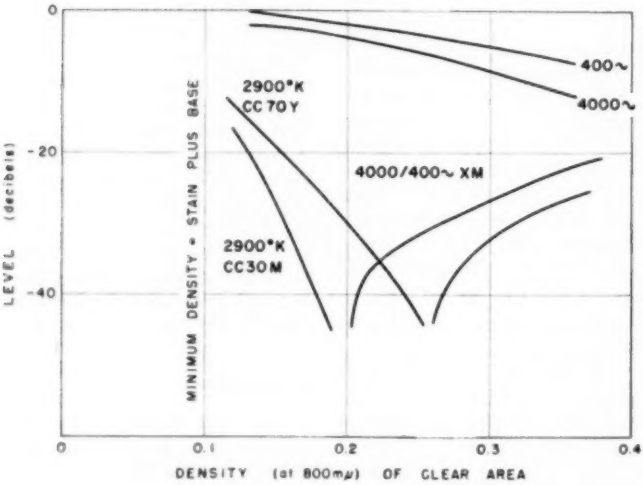

Fig. 6. Cross modulation. Comparison of best variable-area balance with best variable-density balance.

exposed. Density is only significant when the color quality of the exposing light is rigidly specified.

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Discussion

Anon: I'd like to ask the color temperature and the type of photocell used in the playback on all of your test curves?

Mr. Lovick: The color temperature of the lamp used in the reproducer was 2800 K. It does make a difference. We use an unfiltered Type 868 phototube.

Anon: It's a cesium cell?

Mr. Lovick: It's a cesium surface with an S-1 response.

H. R. Kossman (Cameraflex Corp.): I would like to know a little more about the filter for the sound printer. Is it a glass filter you propose to use there?

Mr. Lovick: No, we're proposing to use the Kodak Color Compensating Filters. They are gelatin filters. You have to cool these filters if they're tightly enclosed in some printers, particularly in contact printers. You don't have too much trouble in printers such as the Bell & Howell Model J.

Mr. Kossman: You know, we have rather confined space there. Of course, they have a blower system. . . .

Mr. Lovick: I realize that in many printers there is quite a confined space. However, you cannot get good sound reproduction unless you make some provision for using filters of this type to adjust the printer light to the color quality that will give you the best results.

Mr. Kossman: I notice that some of the labs are using an ultraviolet filter.

Mr. Lovick: The ultraviolet filter gives poorer results than you can expect from the color-compensating type of filter. It also takes considerably more light.

F. P. Herrnfeld (Herrnfeld Engineering): You mentioned a 2-mm heat-absorbing glass. Which one do you use?

Mr. Lovick: We use the Pittsburgh 2043.

Mr. Herrnfeld: Have you investigated single-layer exposures?

Mr. Lovick: Yes, single-layer and double-layer exposures. It's necessary to use preflash techniques in order to avoid unmodulated silver sulfide density in the other layers. There's some improvement possible for variable-density records particularly in the exposure latitude. We don't lower the minimum distortion but gain in latitude by using a Wratten No. 29 filter to preflash the bottom layer. There's no particular value in trying to remove the middle layer of the film. You get improved latitude at the expense of the signal-to-noise ratio.

George Lewin (Signal Corps Photographic Center): Will you tell us how this new Kodachrome is going to be distinguished from the present type?

Mr. Lovick: I believe the last of the old Kodachrome emulsion is 5265-953. The new films are number 1 or later.

Mr. Lewin: It will not be necessary to order it specially?

Mr. Lovick: No.

Mr. Lewin: As time progresses, we'll start getting the new type?

Mr. Lovick: The new type will be supplied as rapidly as possible.

Mr. Herrnfeld: In your test, how do these filters compare with the emulsion pack you use for picture printing?

Mr. Lovick: The filter pack for picture printing is a composite pack consisting of some cyan, magenta and yellow filters. I believe basically it's about 30 cyan, 30 magenta and 10 yellow. That's based again on the 2900 K source that's recommended for Kodachrome picture printing.

Mr. Herrnfeld: Have tests been made using the picture printing filter pack to print the sound track?

Mr. Lovick: The results are poorer than those obtained with a properly color-compensated sound exposure. The filter pack that is used for printing pictures is still almost a neutral pack, as far as that 2900 K source is concerned. There are simply enough additional filters available so that you can remove some to adjust the color quality.

Mr. Herrnfeld: What was the filter pack you mentioned? I mean approximately, is it minus the yellow? The reason I am asking is that I have made extensive tests on other products and I have found that if you get a good gray curve from your film, in other words that the three emulsions give you approximately the same gamma, that is where we had the best processing quality of sound films.

Mr. Lovick: That isn't necessarily true. Each emulsion was designed for a particular dye, irrespective of the amount of halides necessary to get that dye. If you convert those halides to silver sulfide instead of the dye, the curve shapes are no longer similar to what they were for the dye deposits. There's no reason to believe that they'd be similar. The speeds, too, might be quite different. Suppose that you have to have one and one-half times more halides available for the yellow layer than for the other layers in order to get sufficient yellow dye density. When converted to silver sulfide, you would have that much additional contrast in that particular layer.

Densitometry of Silver Sulfide Sound Tracks

By ROBERT C. LOVICK

Silver sulfide deposits have spectral density characteristics which tend to make densitometry less reliable than density measurements of silver deposits. Interference filters may be useful in restricting the bandwidth of response of electronic densitometers so that densitometry of silver sulfide deposits will have increased significance.

THE SOUND TRACK on Kodachrome film and other multilayer, reversal, color films is commonly a deposit of silver sulfide. Silver sulfide images are used because no satisfactory solution has yet been obtained to the problem of producing a good silver image in the sound track area and pictures free of silver in the adjacent area.

The curves of Fig. 1 show density as a function of wavelength for a silver deposit on 16mm Eastman Fine Grain Release Positive Film, Type 7302, and for a reversal silver sulfide deposit on Kodachrome Duplicating Color Film, Type 5265. Physical densitometers usually have maximum sensitivity in the visual region at about 525 mμ. In this wavelength region, the major errors in the measurement of the density of photographically deposited silver are the result of the geometry of the instrument. Differences in spectral response of the receptor have practically no effect on the calibration of the densitometer. The accuracy of density determination may be adequately stated for silver deposits. There is a tendency to assume that the same reliability applies to silver sulfide deposits.

The density of silver is minimum at 525 mμ and increases moderately with wavelength. The density of silver sulfide varies much more with wavelength. Assuming equal densities at a wavelength of 800 mμ, the slope of the spectral density curve for silver sulfide is over six times greater than the slope of the curve for a silver deposit.

The density of the silver deposit measured at 800 mμ is 14% greater than the density at 525 mμ. The density of the silver sulfide deposit measured at 800 mμ is only 40% of the density at 525 mμ. Consequently, silver sulfide sound tracks are visually denser than the density effective in a reproducer with a phototube having an S-1 response. As a result, reversal silver sulfide sound tracks are often seriously overexposed in attempts to give them the appearance of silver sound tracks.

Measurements of sound tracks to obtain indications of the density effective in a reproducer require that heat-

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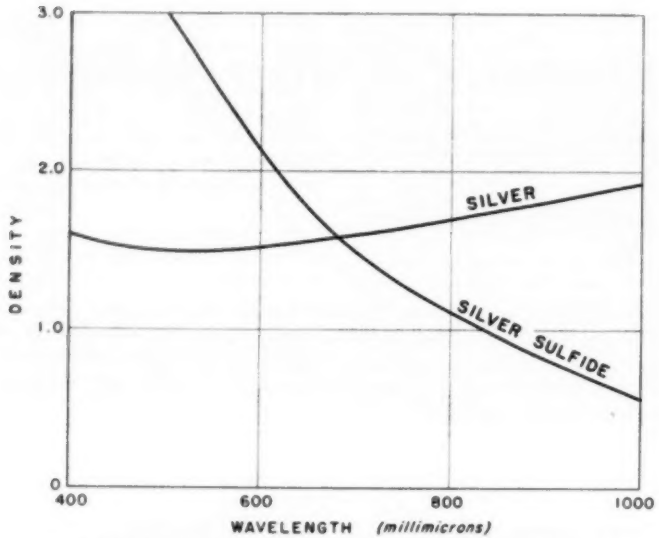

Fig. 1. Spectral density of silver deposits on Type 7302 and silver sulfide deposit on Type 5265.

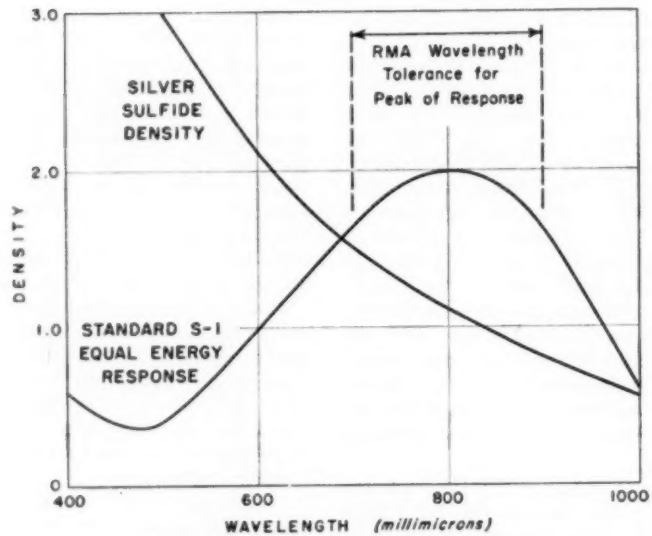

Fig. 2. Standard S-1 Phototube response.

absorbers and other filters be removed from the optics of the densitometer and that the S-4 phototube be replaced with a phototube having an S-1 response.

Wavelength Tolerances

A standard, equal energy response curve of a phototube with an S-1 response is shown in Fig. 2. The peak sensitivity of a standard tube occurs at 800 mμ. Such phototubes were not designed or ever intended for precise photometric measurements. As a consequence of their general purpose design, wavelength tolerance limits of ±100 mμ have been established for the peak sensitivity. These limits are entirely satisfactory for their general purpose service but can produce large differences in the measured density of silver sulfide sound tracks.

For the spectrophotometric curve of silver sulfide shown and the maximum and minimum wavelength tolerances for peak sensitivity of the phototube, it has been computed that the measured density of the sample would be 0.68 and 1.3 respectively. The potential error due to wavelength tolerance alone for peak sensitivity of the phototube is ±30%. On a practical basis, this error seems to be about ±10%.

Color Temperature Effect

The output of the phototube is the product of the equal energy response and the relative energy of the light source at every wavelength. The curves of Fig. 3 show the product of the standard response and the energy of tungsten sources at 2500 K and 3000 K.[1] Of course, some densitometers may have light sources with higher or lower color temperatures than these, but this variation can introduce a significant error in the densitometry of silver sulfide deposits. If a standard S-1 phototube is placed in a densitometer and the color temperature of the light source is changed from 2500 K to 3000 K, the measured density of this sample will change from 0.90 to 1.02. This is a density discrepancy of ±6%.

Variations in Spectral Sensitivity

Another cause of differences in measurements is the effect of different spectral sensitivity for tubes having peak sensitivities at the same wavelength. From a small group of tubes having peak sensitivity at the same wavelength, it appears that this potential error is of the order of ±3 or 4%, possibly larger.

These sources of error are important because they are quite large and yet may be overlooked in the estimate of reliability of densitometry. The tendency is to assume that because measurements on a silver deposit in the visual region indicate an accuracy of 1 or 2%, that measurements on the silver sulfide deposit are of the same order of reliability.

Measurements With Densitometers Having Visual Response

Measurements of silver sulfide sound track densities by densitometers with phototubes having an S-4 response or by visual instruments are much more affected by the variation of density with wavelength than are measurements with instruments having phototubes with S-1 response. Density measurements, in the visual region, of the silver sulfide deposits are more sensitive in detecting density variations than are measurements at 800 mμ, but they are considerably less precise. In addition, sound tracks on Kodachrome films have some unwanted magenta dye present which, although virtually unseen by the usual reproducer phototube, will contribute significantly to the visual density measurement. Visual density measurements may, therefore, show variations which in no way affect sound reproduction. The significance of visual measurements is further reduced by the possibility that as less silver sulfide is formed, more magenta dye will be formed, and although the visual density measure-

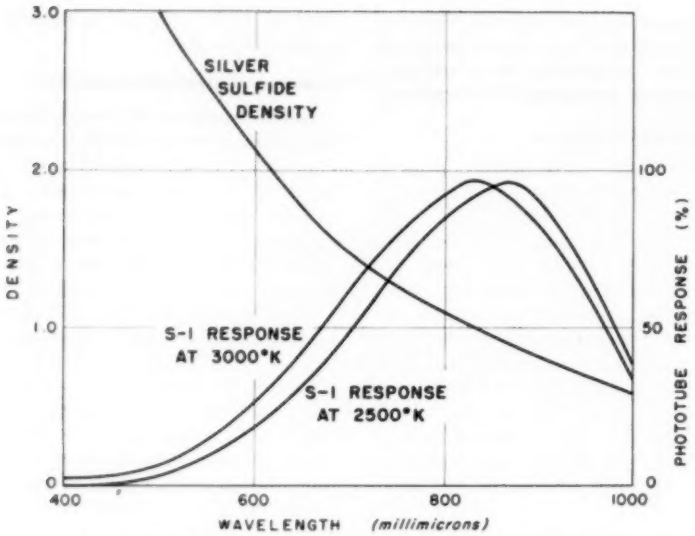

Fig. 3. Effect of tungsten light source color temperature change.

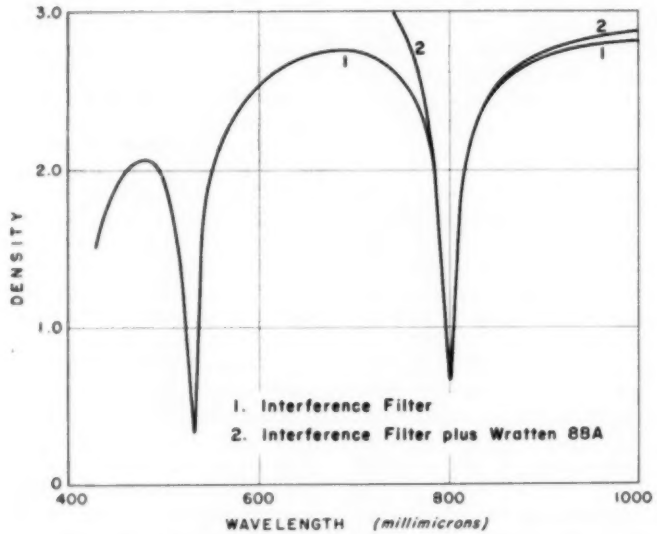

Fig. 4. Spectral density characteristic of one type of interference filter.

ment may be only slightly affected, the phototube of the usual sound reproducer will see a reduced image contrast with definite effect on the reproduction of sound.

Measurements of silver sulfide sound tracks by densitometers with phototubes having S-4 response or by visual instruments are to be discouraged.

Standardized Densitometry

The interchange of useful information on sound track printing conditions would be greatly facilitated by standardized densitometry. The method most likely to produce an acceptable degree of correlation requires the use of an interference filter[2,3] to restrict the response of the densitometer to a bandwidth of a few millimicrons. The density characteristics of one type of interference filter are shown in Fig. 4. With such a filter, the effects of variations of the wavelength of peak sensitivity, shift of peak due to color temperature of the light source, the effects of aging, and differences in spectral sensitivity of phototubes are virtually eliminated. In fact, practically the only sources of error that remain are due either to the geometry of the instrument or to error in the determination of the wavelength of peak transmission of the filter.

The effects of tube responses are eliminated so that the same density is indicated whether an S-1 or S-4 response is used. Of course, the sensitivity with an S-4 response is so much less that it would seldom, if ever, be used.

The filters are relatively dense so that as much as two density ranges may be lost. This restricts the choice of wavelengths for standardized densitometry. If 550 mμ were chosen, the required unfiltered range for the densitometry of a sound track on Kodachrome film would be 0 to 6, since it would be necessary to be able to read to a density of about 3.2. However, at 800 mμ the unfiltered density range required would be only a little more than 3, since the maximum density at 800 mμ of the reversal silver sulfide sound track on Kodachrome film is now under 1.0.

Acknowledgment

The author wishes to acknowledge the contribution of Jack Pinney and Edward Letzer of the Color Control Division in obtaining materials and data for study of the problems of densitometry of silver and silver sulfide deposits.

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Discussion

John G. Frayne (*Westrex Corp.*): I'd like to ask if those figures given for density are diffuse density?

Mr. Lovick: They're diffuse. These densities are measured on the Western Electric RA - 1100B Densitometer modified for this purpose.

Dr. Frayne: With the interference filter in the optical system, what density are you able to measure with the existing amplifier?

Mr. Lovick: We have modified the amplifier so that even with the additional filter we still get a density range of 4.

Dr. Frayne: Is that information going to be available? We'd like to know about it.

Mr. Lovick: You mean how to modify the amplifier?

Dr. Frayne: Yes.

Mr. Lovick: It's only necessary to change a few resistors in the preamplifier.

Dr. Frayne: Even that's worth knowing. Are the interference filters available?

Mr. Lovick: Yes. We've obtained some from Bausch & Lomb. The tolerance which I think we should require is about plus or minus 2 millimicrons in order to get good correlation.

Modulated Air Blast for Reducing Film Buckle

By WILLY BORBERG

Present-day demands for high-intensity light sources point up the need for a suitable technique for reduction of excessive film buckle. Air jets which direct a continuous air flow against one or both of the film faces have been proposed. This technique does not, however, take into account the cyclical nature of film surface deformations during projection. It is found that improved performance can be obtained with a modulated air blast which is synchronized to the frame cycle. This paper describes the cyclical effects involved and shows why the modulated air blast is to be preferred over continuous air blast. It presents experimental data regarding buckle magnitudes in 35mm film and describes the experimental equipment.

THE TYPE OF BUCKLE with which we are concerned in the present discussion is a deformation which takes place during the frame cycle while the film is in the aperture. It may leave no record of its existence on the film after projection. It can be made visible by stroboscopic or high-speed photographic techniques, appearing as a rythmic — almost breathing — motion of the film surface in the aperture. It produces deterioration of image focus during part of the rapidly recurring projection cycle.

The causes of film buckle have been investigated and described before. Carver, Talbot and Loomis,[1,2] as well as Kolb,[3] have done considerable work on the subject in connection with broad studies of film performance. They have developed the terminology needed for presentation and their usage will be followed. The present discussion will be concerned with those effects which vary during the film frame cycle. However, a brief statement of the basic factors will not be amiss.

Each single picture frame goes through a cycle which starts with pulldown into the aperture, proceeds through the first exposure, the flicker blade cutoff and the second exposure, and ends with the pulldown of the next frame. During the two exposure intervals the film arrests some of the radiant energy from the light source and transforms it into heat. This causes the film to buckle (or bulge) in a manner very similar to that observed in the operation of a bimetallic element.

Presented on April 25, 1952, at the Society's Convention at Chicago, Ill., by Willy Borberg, General Precision Laboratory, Inc., Pleasantville, N.Y.

The emulsion, being more opaque than the base, absorbs energy, expands and becomes the outer or convex surface of the bulge. The magnitude of the deformation produced varies continuously during the frame cycle and by an amount which is more than sufficient to affect sharpness of image focus.

The emulsion side of 35mm film is toward the light source; and hence the film tends to move toward the light, away from the lens, while it is in the aperture.

In accordance with the accepted terminology, the deformation is called *negative* when the emulsion side is convex, and conversely, *positive* when the emulsion side is concave. Flat film is considered to have *zero* deformation.

The film upon entering the projector gate is not necessarily flat, but may have a slightly positive curl, the magnitude of which depends to some extent on the age and condition of the film. It appears that there is some shrinkage of both emulsion and base, the emulsion shrinking more than the base, so that the resulting curl is slightly positive. Typical positive displacement at the center of cold 35mm film as it enters the gate is between zero and 0.010 in.

Instantly upon registration of the film frame with the aperture, the shutter uncovers the light for the first exposure of the cycle. Light energy is absorbed in the emulsion and transformed into heat. The expanding emulsion causes the exposed portion of the film frame to move from its initial zero or positive position, shifting it to a negative position, and causing it to take a somewhat spherical shape. There is a constantly increasing deformation during the first exposure, and a constantly changing distance of the emulsion surface with respect to the lens. Upon interception of the light by the flicker blade, further movement of the film surface toward the light source comes to a halt. With no light on the film, heat absorption by the film cannot take place. Instead, there is a loss of heat which causes the film to recede slightly toward the zero plane. At the start of the second exposure, the film surface stands somewhere between zero and its former maximum negative position. During the second exposure, the film continues its excursion negatively, first rapidly, then leveling off. At the end of this exposure the film reaches a more negative position than at the end of the first exposure.

Figure 1 shows the correlation between the movement at the center of the film surface and particular instants in the frame cycle. The same movement occurs at points off the center of the film surface, though to a smaller degree. A significant effect which may be noted is that the center of the film, which is in motion during the entire cycle, travels through and beyond the acceptable focus limits defined by the depth of the focus of the projection lens.

The projectionist, whose eye just cannot follow this rapid sequence of events (48 times per second), has to pick a "best average focus" position of the projection lens, somewhere between the maximum positive and maximum negative of the two exposure periods. If he judges the focus at the center of the screen, he picks a "best average focus" position near the maximum negative buckle of the first exposure. The remaining, earlier part of this exposure produces only a poor and undefined image on the screen. A portion of the second exposure, also, is beyond the limit of good image definition on the screen, and good optical performance can take place only during that part of the exposure in which the film displacement line lies within the depth-of-focus range. The "best average focus" thus obtained gives the best attainable image at the center of the screen. Actually, in practice, the projectionist may choose a slightly less negative lens position, which is a compromise to gain relatively fair overall definition across the whole screen. Even this compromise results in a fairly large percentage of "out-of-focus" time during a cycle.

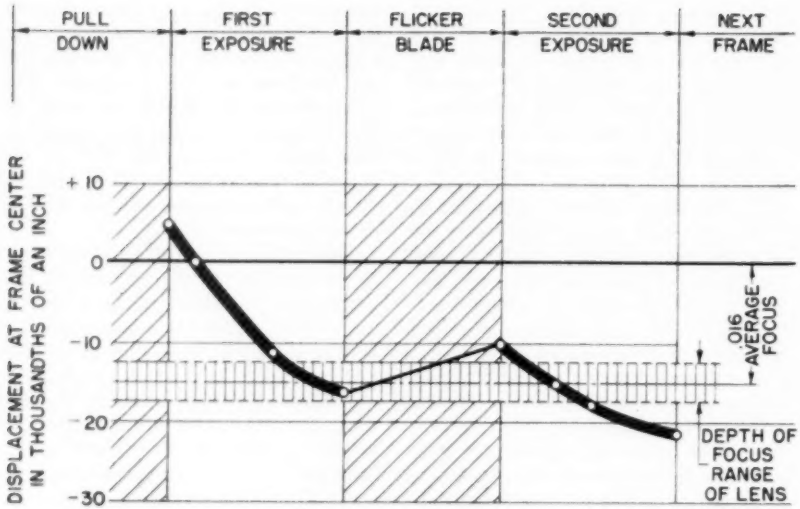

Fig. 1. Film displacement due to buckling at center of frame—No Air.

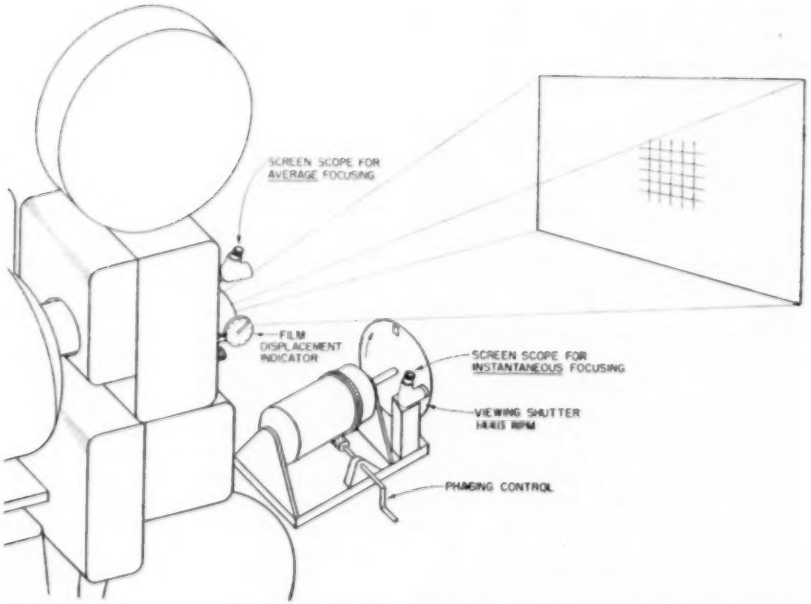

Fig. 2. Test equipment used to determine film buckle magnitudes and time relations.

For the conditions demonstrated in Fig. 1, good optical performance is attained during only about 40% of the first exposure and 60% of the second exposure, or a total of only 50% during a complete frame cycle. This is the best the projectionist can do.

The figures so far presented demonstrate the magnitude of the defect with which we are concerned, since they have been obtained with representative equipment, operating under conditions which might be found in any large theater. For test purposes, the projector was fitted with facilities to determine the various focus positions of the 5-in. focal length f/1.9 projection lens.

The light source was a Hi-Candescent Arc Lamp, with F-2 condensers, burning at 160 amp and delivering about 9000 lm to the screen with the shutter running.

All focus settings were made with the aid of Simplex Screen Scopes. The 8-power magnification thus provided enabled lens adjustment with greater precision than could have been attained by direct observation of the screen from the projector.

The film plane position along the optical axis was measured directly in terms of lens displacement, a dial indicator calibrated in thousandths of an inch being affixed to the lens mount for this purpose. Initial calibration for zero position on the dial indicator was made by focusing the lens to produce a critically sharp image of a conical hole in a flat steel plate, the small end of the hole being in the same plane as the emulsion contacting surfaces of the film trap. Up to this point, the method and equipment are essentially the same as those employed and described by Kolb.[3]

The addition of a viewing shutter to the equipment enabled observation of successive phases of the cyclicly varying film frame motion (see Fig. 2). The viewing shutter's drive-motor stator was rotatable so that the shutter opening of about 9° could be phased with relation to the synchronously running projector. This stroboscopic arrangement made it possible to view the screen image in small time increments of about 1 msec through all exposure phases of successive frame cycles. The film emulsion position during any specific phase of the exposure periods could thus be established without regard to possible out-of-focus conditions during the remaining unobserved portions of the cycle. Dial indicator readings were then recorded in relation to the phase settings. A contactor on the projector shutter timed a short-duration light flash for establishing correct phase reference.

The equipment as described permitted studies of film behavior under actual operating conditions.

The technique of air-blast cooling of film, by which opposing air forces of the front and rear jets are adjusted so as to produce a force for positioning the film, was found to be at best a partial solution to the problem. It is possible to move the film by this method and to shift the average focus position; the resultant force, however, acts upon the film continuously, and therefore, cannot correct for the intermittent cyclical frame deformations caused by the internal buckling forces in the film which occur during the two exposure periods.

The center of each frame travels over a range of about 0.020 or 0.030 in. This range is not greatly reduced by application of a continuous displacing air force (Fig. 3). The continuous jets produce a shift in average focus position; this, by itself, only slightly alters the ratio of "in focus" and "out-of-focus" intervals. The air serves primarily as a cooling agent, preventing possible damage to the film in the form of embossing or blistering or the formation of permanent buckle.

It was felt that, because of the cyclical nature of the film frame deformations involved, any corrective action to neutralize the defects should be similarly cyclical. Hence, the following approach (Figure 4) was tried:

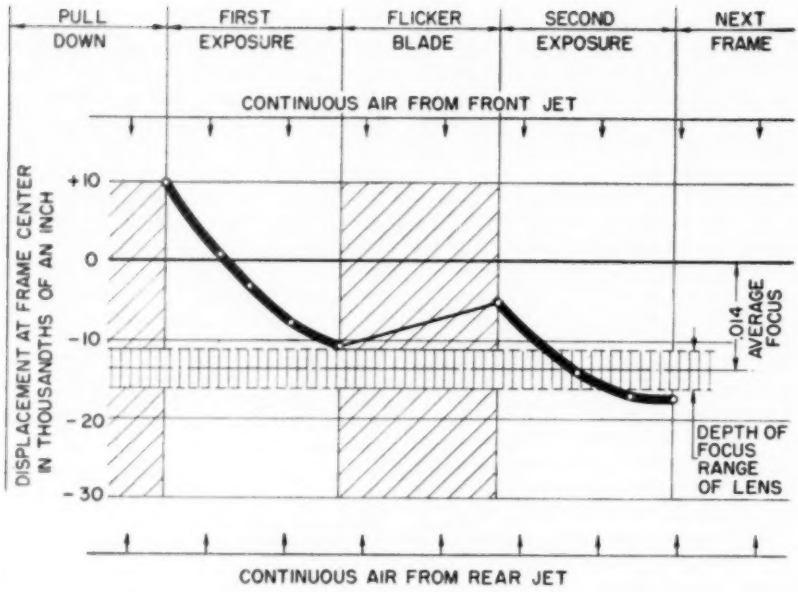

Fig. 3. Film displacement due to buckling at center of frame—Continuous Air.

(a) The air from the front jet was modulated by means of a rotary valve driven from the shutter shaft.

(b) The air from the rear jet was not modulated and the steady stream of air from this jet was used to force the film toward the lens, thus partly neutralizing the internal forces, which tend to make the film take a deep negative buckle under the influence of light.

(c) The correcting air pulses from the joint jet were timed so that the resultant forces from both front and rear jets opposed the cyclicly varying buckle forces. The motion of each film frame on the optical axis could thus be controlled.

Figure 5 illustrates the timing of the jets and shows that the position of the film frame can be held steady within fairly close limits. It should be noted that the excursions of the film frame surface can be confined to the depth-of-focus range of the lens. Good optical performance is thus attained over virtually the entire frame cycle.

Figure 5 also shows that a negative displacement of approximately 0.012 in. is allowed to exist at the center of the frame. The question may be asked, "Why is the process not carried beyond this point so as to bring the displacement to zero?" There are two reasons for not doing so. The first, as pointed out by Kolb, is concerned with the performance of the projection lens. In most projection lenses the focal plane of field is not truly a plane, but rather a curved surface. For best performance in this respect, the film is allowed to approximate this surface. The second reason is that flat film seems to be somewhat flaccid under the influence of air flow, as compared to film which is bowed to even a slight degree.

Since the film can be kept within the depth-of-focus limit of the projection lens during nearly the entire time of the two

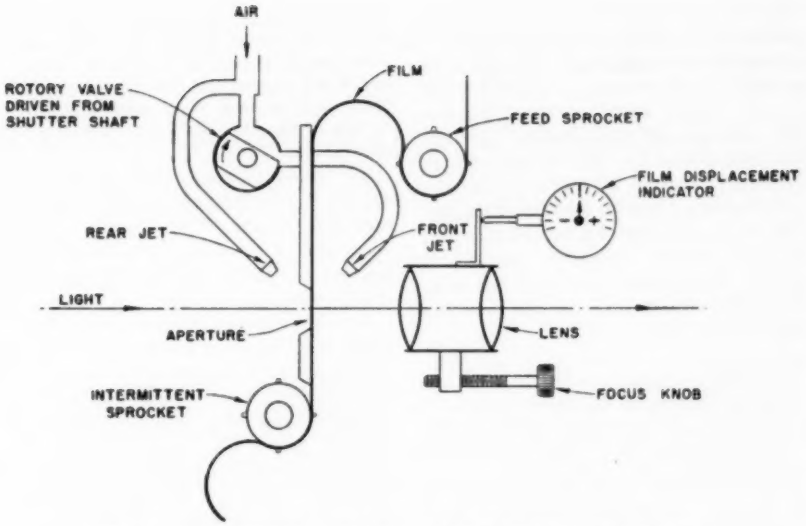

Fig. 4. Arrangement of air jets and film displacement indicator.

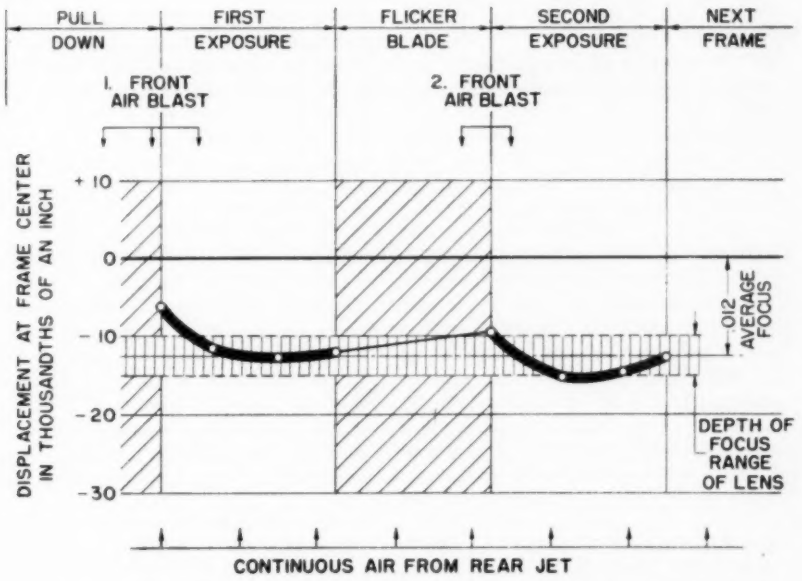

Fig. 5. Film displacement due to buckling at center of frame—Pulsed Air.

exposure periods, there is marked improvement in screen image definition.

Experiments so far have been directed toward the use of the modulated front jet. It is quite possible to use the opposite arrangement of a steady front jet and pulsed rear jet. For better cooling, however, it seems advisable to let the continuous air stream wash the emulsion side of the film, relying on the front jet as the position correcting agent. A pulsed combination of both jets may offer some advantages in air economy, but has not been tried.

References

1. E. K. Carver, R. H. Talbot and H. A. Loomis, "Effects of high-intensity arcs upon 35mm film projection," *Jour. SMPE, 41:* 69–87, July 1943.
2. E. K. Carver, R. H. Talbot and H. A. Loomis, "Film distortions and their effect upon projection quality," *Jour. SMPE, 41:* 88–93, July 1943.
3. F. J. Kolb, Jr., "Air cooling of motion picture film for high screen illumination," *Jour. SMPE, 53:* 635–664, Dec. 1949.

Discussion

R. T. Van Niman (RCA Victor Div.): I perhaps missed something in the early part of the talk, but did you consider whether or not the amount of deformation varies with the type of picture material? I believe Mr. Kolb pointed out that the amount of buckling depends to some extent upon the density of the film in the aperture at that time.

Mr. Borberg: Yes, it does matter, but there is always deformation, even with a very low density. The worst condition occurs with a dark film, and necessarily the amount of buckle depends also on the energy of the light source.

Mr. Van Niman: No attempt has been made to compensate for the variation in density along the film then?

Mr. Borberg: No. A photocell device operating from screen illumination to control air blast has been considered. Such a device would compensate for scene-to-scene variations which are beyond the projectionists' ability to follow, but the instrumentation just hasn't gone that far.

W. W. Lozier (National Carbon Co.): Does the intermittent air blast make much audible noise?

Mr. Borberg: Yes, there is some noise, but it's not very disturbing and it does not exceed the noise of jets with continuous air. There is a purring noise, I might say.

A Method of Direct-Positive Variable-Density Recording With the Light Valve

By O. L. DUPY

In this system the light valve is placed in the cathode circuit of a nonlinear amplifier, the nonlinearity being of such a nature that the relation between the input to the amplifier and the transmission of the developed film is linear over a large percentage of the film-transmission range. The method of determining the shape of the necessary nonlinearity and how it is produced is described.

MAGNETIC FILM has proved to be an excellent medium for sound recording in the motion picture industry. However, considering the well-established editing techniques and the existing editing and viewing equipment, it will be some time before the magnetic record will replace the photographic sound record for use throughout the studio. The economical method of obtaining this record is to transfer the sound electrically from the magnetic record to a film that has the characteristics of a print when developed.

The making of direct-positive prints by electrical printing has several advantages. The most important is the saving of the negative film and the cost of the development and printing of this film. Also, the reduction of the time that elapses between the recording and the delivery of a print is sometimes of great importance. Another advantage is the reduction of the film background noise by the elimination of the film noise, inherent in the negative, which is added to the print. Another advantage is the elimination of the flutter introduced by the printer, which is generally the contributor of a good percentage of the total flutter in film recording.

The main disadvantage in obtaining a linear recording from a variable-density type of photographic characteristic is the rather elaborate amplifier system required to offset this distortion, but one or possibly two such units will handle all the daily printing for a large studio. The push-pull variable-area method of recording has been successfully adapted to produce these direct-positive prints.* With the push-pull system a higher track

Presented on April 25, 1952, at the Society's Convention at Chicago, Ill., by John G. Frayne for the author, O. L. Dupy, Metro-Goldwyn-Mayer Sound Dept., Culver City, Calif.

*L. I. Carey and Frank Moran, "Push-pull direct-positive recording—an auxiliary to magnetic recording," *Jour. SMPTE, 58:* 67–70, Jan. 1952.

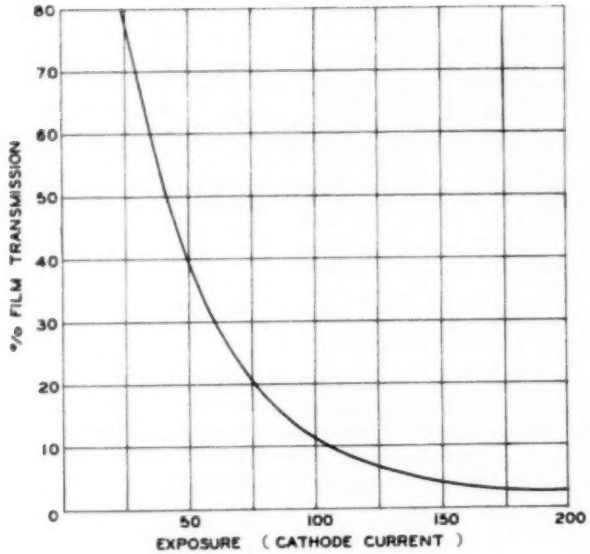

Fig. 1. Film-recording characteristic.

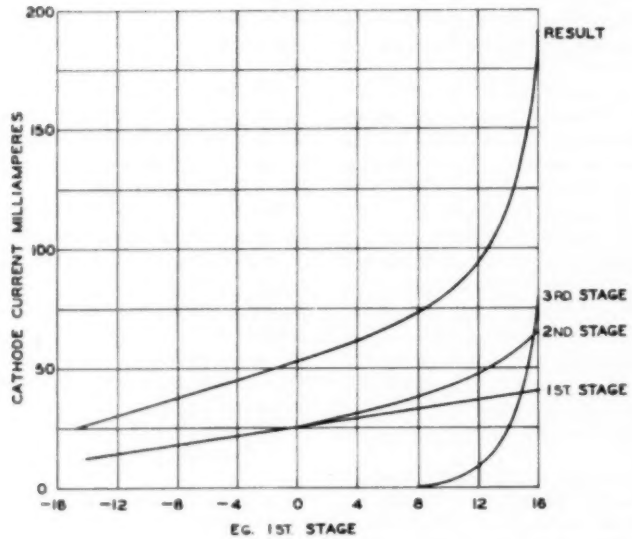

Fig. 2. Correcting nonlinear amplifier characteristic.

density than normal can be employed because of the cancellation of the cross-modulation products in push-pull reproduction, thus producing results that equal the cancellation achieved by the normal negative and print process. The nonlinear exposure versus light-transmission characteristics of the film enters into the problem of making a variable-density direct-positive. In order to determine the nonlinear characteristics, samples were exposed by sending direct current in fixed steps through the light valve in a standard recording machine. These strips were processed using the M-G-M standard release development procedure. The resulting strips were measured by inserting a 400-cycle chopper in the light beam of a standard film-reproducing machine and measuring the audio signal at the output of the photoelectric cell amplifier. By this procedure, the test included all the variables encountered in the recording and reproducing systems.

The resulting characteristic is shown in Fig. 1. The above tests were repeated over a period of time in order to check the stability of the variables involved. The results proved that this method of making a variable-density direct-positive was practical.

Figure 2 shows the schematic of an amplifier, the characteristics of which are the reciprocal of Fig. 1. The first stage of the amplifier has a practically linear characteristic and is used as a voltage amplifier directly coupled to the second and third stages or sections. The noise-reduction control voltage is fed to the input grid in series with the secondary winding of the input transformer. The second stage controls the shaping of the middle and upper end of the curve by being biased negative almost to cutoff; the signal received from the cathode resistance of the first stage is such that it is linear for the lower half of the range, and becomes nonlinear as the driving signal increases. The third stage controls the shaping of the extreme upper end of the curve. This is accomplished by biasing the grids negative beyond cutoff and driving them with a signal voltage that will cause the tubes to conduct only on the positive peaks of the signal.

Figure 3 shows the method of obtaining this curvature by using a number of tubes in parallel, the grids of which are biased to operate at various points in the nonlinear portion of their grid volts versus plate-current curves. The overall shape is obtained by adjusting the balance between the grid and signal voltage, and the number of tubes used.

The light valve must be directly coupled to this amplifier because the resulting distorted signal is composed of direct current; the signal fundamental and a large amount of harmonics of the signal, and in addition the noise-reduction signal must be altered by this circuit.

Figure 3 shows the contributions of all three stages and the overall characteristic of the nonlinear amplifier. A Western Electric RA-1238, 200-mil push-pull variable-density light valve was used in these studies and in recording the demonstration film which was run at the close of the paper. It is necessary to employ one amplifier of the type shown in Fig. 2 for each component of the push-pull valve. This results in a classical type of push-pull reproduction, and a higher degree of an overall linearity is obtained than when using a standard single track. However, good quality is obtained from a single track provided care is taken in the setting of the operating parameters.

A direct current is applied to the light valve, in opposition to the cathode current, for adjusting the static opening of the valve for zero signal input. A noise-reduction bias current is applied to each component of the light valve through its associated amplifier. Since the resulting sound track is in effect a positive, the ribbons are either mechanically or electrically biased open, rather than closed as in a normal negative-positive recording. The action of the input noise-

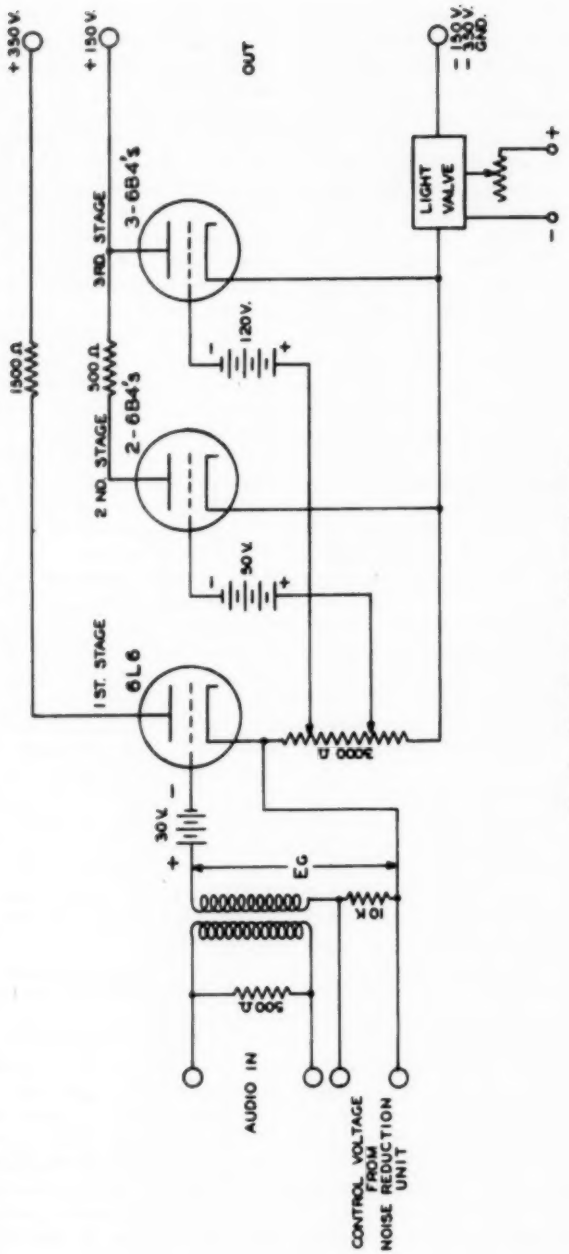

Fig. 3. Nonlinear amplifier schematic.

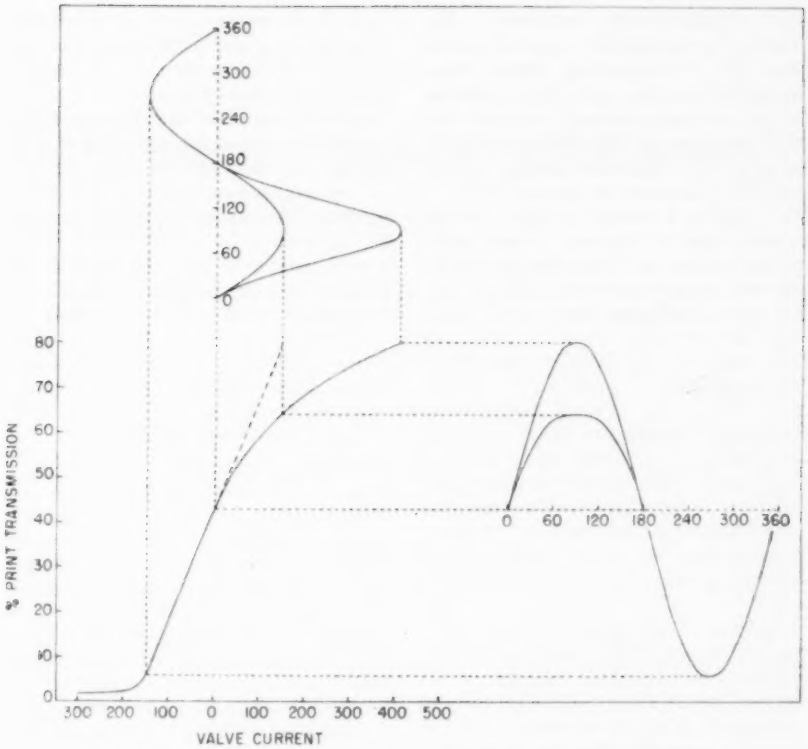

Fig. 4. Predistortion curve for extended range recording.

reduction voltage then serves to cancel this d-c bias, the minimum spacing of the ribbon being obtained for maximum signal input. Experience has shown that noise reduction equivalent to that obtained in ordinary recording can be obtained in this method of recording.

The shape of the correcting curve was checked by recording signals at various levels and measuring the distortion. The part of the curve that was incorrect was found by measuring the distortion of a low-level signal that was moved in steps, over the complete range of the characteristic, by independently varying the noise-reduction control voltage. This information was used for final individual adjustment of each section of the amplifier.

It should be noted that the current required from the B supply varies at both the signal envelope and audiofrequency rates. A regulated B voltage supply having a rapid recovery rate and a low internal impedance of about 0.9 ohms was satisfactory. The necessary maintenance, checking and adjustments have been reduced to a routine. We anticipate that experience will produce a system with better uniformity and quality than the negative and positive system.

Having developed a nonlinear system with adjustable characteristics, we have adapted it to extend the volume range of the print made from a standard nega-

tive variable-density recording. This is done by making the amplifier linear over the corresponding linear film-transmission range and then nonlinear in the direction necessary to correct the film curvature in the high transmission range. The maximum volume output has been increased by approximately 6 db. Figure 4 shows a typical overall negative-positive exposure versus transmission curve, and illustrates the distortion that occurs when attempting to use the full transmission range of the film. Figure 4 also shows how by distorting the input signal a sine-wave result can be produced that extends over the transmission range from 5 to 80%.

M-G-M has used the direct-positive system described in this paper for several months experimentally to make temporary recordings for previews and in other intrastudio operations. The sound quality has proved to be invariably satisfactory indicating that this method of transferring from magnetic originals to direct-positive density is quite feasible.

International Auxiliary Language for Motion Pictures

Before reading the article by Otto C. Bixler beginning on page 109, please read the page of Interlingua translation immediately following this and see how much of it you can understand at sight.

Interlingua is the nearest attainment of a workable international language for the contemporary world which modern linguistic science can produce. This is the claim of the International Auxiliary Language Association (IALA) as the result of many years of research on one of the most timely problems of communication. IALA's research was set up by noted linguists in Europe and the United States and has been carried out by a staff of experts in different languages.

IALA's staff has devised a system for screening off words which are internationally known and for giving them standardized forms and definitions. Some 27,000 of them are presented in the *Interlingua-English Dictionary*. A simple grammar employing only those features which languages have in common has been prepared to operate this *natural* international vocabulary.

Interlingua includes general and technical words of every type. Words from the Romance languages dominate the general vocabulary. The technical terms drawn directly from Latin and Greek are in the majority for the reason that the international world of science and technology is constantly creating its own international language.

While Interlingua is basically a Western language it does not exclude any Oriental words in international circulation.

An auxiliary language *to supplement* mother tongues should represent as many national languages as possible. Interlingua has the psychological asset of looking familiar to a world of readers comprising North America, South America, Europe, and readers in Asia and Africa who know one of the European languages.

IALA is bringing Interlingua to the attention of groups of scientists and technologists. The Association will welcome suggestions and comments from readers of the *Journal of the SMPTE* as to possible collaboration with engineering groups at the heart of the motion picture industry. The eventual use of Interlingua in export-film captions is not beyond practical imagination in the development of world markets.

Alfred N. Goldsmith, Past-President of the SMPTE, has been a member of the Board of Directors of IALA since its founding. The headquarters of IALA are at 420 Lexington Ave., New York 17, N.Y.

This presentation has been prepared through the kindly offices of Dr. Alfred N. Goldsmith. This brief description of Interlingua has been prepared by Mary Bray, and Dr. Alexander Gode has translated into Interlingua the page immediately following. Both are staff members of the International Auxiliary Language Association.

Un commercial phonoregistrator binaural

Per OTTO C. BIXLER

Le disveloppamento hodierne del apparatura de phonoreproduction es multo avantiate. Proque le avantages del registration stereophonic ha previemente essite demonstrate, nos ha credite que le proxime desiderato re apparaturas commercial esserea le fabrication a precio rationabile de un systema binaural. Nos presenta hic un revista del factores theoric implicite in binaural phonoregistration e reproduction, insimul con un description del apparatura technic disveloppate pro satisfacer le requirimento de alte qualitate acustic intra le limites de rationabile costos total. Nos describe alicun nove problemas e effectos incontrate in iste programma de disveloppamento.

Desideratos structural del apparatura binaural

Le decision a preparar pro uso commercial un binaural registrator a banda resultava del desiro de suppler phonoregistrantes con ameliorate e nove methodos de presentation. Esseva prendite in consideration le facto que usque nunc nulle binaural apparatura vermente commercial ha essite presentate al publico ben que numerose firmas (inter illos Bell Laboratories, Fox Studios, Warner Bros., e alteres) ha facite multo satisfactori demonstrationes stereophonic. Post le qualitate de phonoreproduction habeva essite avantiate a su presente alte fidelitate con excellente responsas a frequentia, minimal cambiamentos de phase e bon reproduction transiente, on recognosceva que alique, nonobstante, mancava. Iste "alique" es le distribution spatial del sono original. Le reproduction monaural del sono emanante de multiple fontes a disposition spatial introduce distortiones spatial. Le optime methodo a eliminar tal distortion es reproducer sonos stereophonicamente. Ver stereoreproduction de sonos es technicamente satis difficile e relativemente costose. Le secunde optime methodo es le binaural phonoregistration e reproduction. De facto, sonos binaural reproducite per medio de receptores auricular resulta pro le auditor in un quasi perfecte recreation del phonoimpacto original.

Theoria de audition binaural

In principio, le factores theoric del phonopresentation binaural visa a producer, a un plus tarde tempore, le mesme amplitude de sono e relation de phases in cata un del duo aures del auditor como si ille habeva essite originalmente presente. On debe notar que le aures e le cerebro del auditor constitue un systema de computation directional basate super lor sensitivitate a phases e amplitudes. Iste systema dual involve un area intersectional de "sensitivitate contra frequentia" que es determinate sequentemente:

Presentate le 24 de april, 1952, al convention del Societate a Chicago, Ill., per Otto C. Bixler del firma Magnecord, Inc., 225 W. Ohio St., Chicago 10, Ill.

A Commercial Binaural Recorder

By OTTO C. BIXLER

Present-day sound recording-reproducing equipment is at a very high state of development and, since the benefits of stereophonic recording have been previously demonstrated, it was believed that the next desirable step in commercial equipment would be the manufacture of a reasonably priced binaural system. A review of the theoretical factors involved in binaural sound recording and reproduction is presented along with a description of the technical equipment developed to fill the needs of high-quality binaural sound consistent with a reasonable overall equipment cost. Some novel problems and effects experienced in this development program are described.

Binaural Equipment Design Objective

The decision to design a commercial binaural tape recorder was based upon the desire to provide the recording field with an enhanced, novel method of sound presentation. Consideration was given to the fact that to date no true commercial binaural equipment had been presented to the public although many concerns, including Bell Laboratories, Fox Studios, Warner Bros., and others, have given highly satisfactory public demonstrations of stereophonic sound. After the quality of sound reproduction was brought to its present high fidelity with excellent frequency response, minimum phase shift and good transient reproduction, it was realized that something was still lacking. That something is the normal spatial distribution of original sound. Monaural reproduction of a spatially disposed multiple sound source introduces spatial distortion. The best way to eliminate this distortion is to reproduce sound in a stereophonic manner. True stereosound is quite difficult of technical achievement and is comparatively costly. The next best method is the use of binaurally recorded and reproduced sound. As a matter of fact, when binaural sound is reproduced through earphones an almost perfect re-creation of the original sound impact upon a listener is obtained.

Presented on April 24, 1952, at the Society's Convention at Chicago, Ill., by Otto C. Bixler, Magnecord, Inc., 225 West Ohio St., Chicago 10, Ill.

Binaural Hearing Theory

Basically, the theoretical factors involved in binaural sound presentation are aimed at producing, at a later time, the same sound amplitude and phase relationship in each of a listener's two ears as if he had been present originally. It is to be noted that a listener's ears and brain constitute a directional computing system based upon their phase and amplitude sensitivity. This dual system has a sensitivity-versus-frequency crossover area determined as follows:

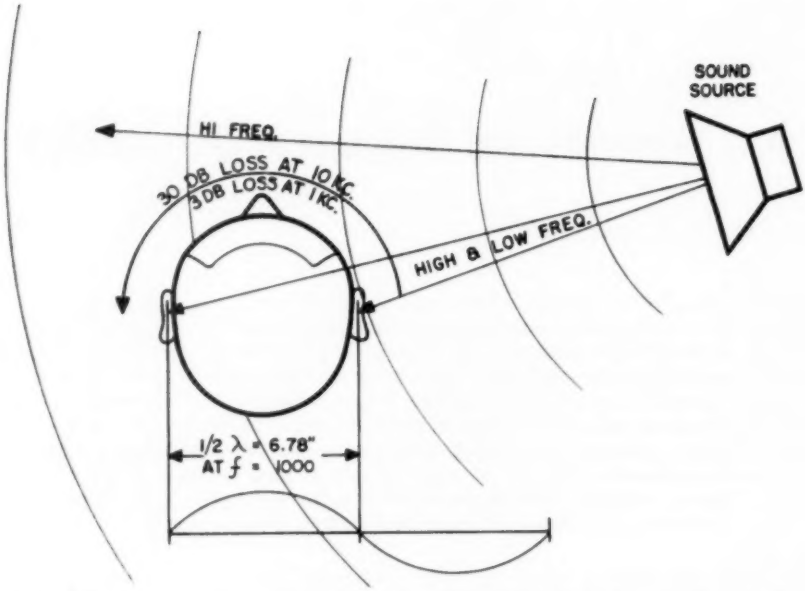

Fig. 1. High frequencies pass by an observer's far ear. Low frequencies readily curve around the cranial obstruction to the far ear.

The average human-ear phase-sensitivity range is from some very low frequency up to approximately 800 to 1000 cycles/sec, which thus allows a perception of directivity by binaural phase comparison over this range. The amplitude sensitivity range of the individual ear is from the lowest frequency perception point up to the highest frequency perception limit within the dynamic volume range of the ear. This dynamic volume range is defined by the standard Fletcher-Munson hearing curves modified by the room masking noise level.[1]

By simple amplitude comparison a mental computation of directivity may be obtained, except as limited by the physics of sound propagation. This means that due to the lack of directivity of low-frequency sounds below, say, 800 to 1000 cycles, the ear's amplitude-detection ability is of no avail, since a low-frequency sound wave curves around the head without appreciable amplitude loss. Therefore, the amplitude-derived directional sensitivity of the binaural ear arrangement falls off rapidly. This is exemplified by the fact that a 1000-cycle/sec tone directed toward a listener from one side of his head produces only a 3-db level difference at his far ear compared with the near ear; a 10,000-cycle/sec tone under the same conditions produces a 30-db level difference (Fig. 1).

It may be shown that the portion of normal auditory perspective due to phase sensitivity is related to the lineal distance between the human ears. Let us assume that a theoretical observer has a between-the-ears distance of, say, 6.78 in. Under certain environmental conditions the speed of sound in air is, say, 1130 ft/sec. The maximum frequency, f, that the ears may compare

phase on, has a half wavelength, $\lambda/2$, equal to the distance between the ears (Fig. 1). Therefore, if:

$$\lambda = 6.78 \times 2/12; \quad \text{then } f = \frac{1130}{\lambda} = \frac{1130}{6.78 \times 2/12} = 1000 \text{ cycles/sec.}$$

That is, the maximum possible frequency for binaural phase detection by this theoretical observer is in the order of 1000 cycles/sec or less.

Most speech sound sources possess frequencies both above and below the crossover frequency range of from 800 to 1000 cycles. Not only does this enable the observer to compare angular location by both phase and amplitude methods (and to derive a more accurate location), but since phase shift of a given frequency is a function of both angular position as well as distance, it provides a measure of the distance to the sound source.

In addition to the localization system defined by the base distance between the ears and the mental computation of angles, the mind has an additional distance-computing ability based upon the ratio of direct sound to reverberant sound impinging upon the eardrum.

Microphone Placement

In view of the above, it becomes immediately apparent that in order to record binaurally for later binaural reproduction some care should be exercised in microphone placement.

The first basic principle underlying microphone placement is that the perpendicular bisector of the line joining the pickup microphones represents the center line of a fictional listener's position. During reproduction, the loudspeaker placement should be such that the perpendicular bisector of the line joining the loudspeakers coincides with the real listener's center line. This arrangement results in both depth and lateral stereophonic "image" location, dependent upon both phase and the intensity ratio of the direct sound picked up by the two microphones.

The second principle underlying microphone placement affects the apparent position of the sound behind the immediate foreground. The distance of the source from a single microphone is also determined mentally by a comparison of the reverberant sound to the direct sound. The most accurate mental calculation is made when this ratio is not in the extremes. Therefore, both exceedingly close and overly distant microphone placements are to be avoided.

Under a strict binaural microphone arrangement the two microphones should be relatively close together and have individual pickup patterns approximating those of the human ear; the placing of an acoustic septum between the microphones would be desirable. Under an expanded arrangement, wherein a simple stereophonic system is obtained, the microphones are spaced quite widely apart and a third microphone with isolation amplifiers and attenuators is added midway between these two primary microphones. The object of the center microphone is to feed a small amount of sound energy to both recording channels and thereby to correct for the spatial distortion occasioned by moving the primary microphones apart.[4] Unless this correction is made, some depth location error occurs, especially in the area midway between the primary microphones. If some depth location error may be permitted, which it may be if the sound is not associated with a concurrent motion picture, then it is readily possible to omit the center microphone.

Binaural Presence — Listening

The physiological sense satisfaction that yields the psychological impression of being present in a nonexistent room is the startling factor in listening to a binaural recording for the first time. The sense of "presence" obtained is

considerably different from the normal usage of this word. In accepted sound practice the reproduction objective is to bring the sound source into the presence of the listener. Listening to a binaural recording can best be described as literally taking the listener into the presence of the scene where the original recording was made.

This effect of realism is particularly effective when listening with headphones. When considering theoretical factors it would not seem that loudspeaker listening would be very effective for binuaral reproduction. However, listening tests readily convince one that considerable enhancement is still retained with speakers although not of such a high order as that of earphone listening. The use of earphones prevents a listener from turning his head to aid in localizing sound sources; loudspeaker reproduction on the other hand allows a listener to retain this mechanical aid to localization. Loudspeaker placement is of considerable importance in good reproduction. The use of too large or too "live" a room or too great a listener distance greatly reduces the effectiveness of binaural loudspeaker reproduction.

Random Noise Correlation

An unexpected effect was noted when some rather poor recordings were unintentionally made and then played back. When the recording medium or equipment random-noise level is high with respect to the level of the recorded signal a unique result ensues. The random nature of this white noise is such that it allows false phase and amplitude coincidence to be correlated by the brain to produce apparently localized sources of noise. The localization means focused listening attention; the effect thus results in raising of apparent loudness of discreet noise "pulses." Since these pulses are strictly random mental correlations, their number is far less than the actual number of white noise "pulses"; therefore, the net effect is a coarsening and apparent increase of the background noise level to the listener. Practically speaking, this means that binaural recordings made for maximum music appreciation should be made with particular care toward maintaining the best overall measured signal-to-noise ratio.

The Tape Transport

The development of the binaural tape transport from a standard recorder was very desirable in order to keep manufacturing costs down and allow sales at a reasonable price to the customer without the necessity for designing a new special unit with its attendant reflected high sales price. It was found possible to extend the development of a standard Magnecord PT63-A tape transport mechanism for use in a binaural recording system. This basic tape transport mechanism possesses an assembly incorporating three heads. The tape passes in succession over, first, the erase head, then, the normal recording head, and, thence, over the tape monitor head before it is pulled by the capstan and fed to the take-up reel.

Consideration was given to the possibility of retaining the tape monitor feature for the binaural system. However, it was determined that the additional system complexity would add materially to equipment size and costs because of the immediate requirement for two monitor heads and two amplifier monitoring channels as well as extra controls. The mechanical layout of the front panel of the existing PT63-A tape transport unit would also be unduly complicated by the addition of the two extra magnetic heads required. It was, therefore, decided that the normal full-track record head would be replaced by a half-track record head and the position normally occupied by the monitor head would be used for a second half-track record head for the other half of the tape.

It is of interest to note that in this standard unit the erase head forms the principal load for the 60-kc erase and bias oscillator with the record head bias coil being a relatively small series impedance in the circuit. It was therefore possible to add the bias winding for the second recording head in series with the existing erase and record heads without any appreciable net change in bias or erase currents. Using the above-described arrangement it was then only necessary to supply proper pole pieces, and to reconnect the internal wiring to the heads to accommodate the second recording channel. Plug and receptacle arrangements are so chosen as to automatically maintain channel identity in the interunit cables.

With the exception of the nameplate, there is no apparent difference between a binaural Magnecorder and a normal single-track unit unless the magnetic head covers are lifted to allow a view of the half-track pole pieces which do the recording. The half-track pole piece consists simply of a normal full-track pole piece with approximately $\frac{1}{2}$ of the Mu-metal cut away and a brass insert soldered into its place in order to fully support the tape.

The Amplifier Unit

The development of a binaural recording and reproducing amplifier was essentially a specialized packaging job which involved building a new portable dual amplifier unit, each amplifier having all the characteristics of existing unit standard amplifiers. The packaging was accomplished with only a minor increase in space and weight for the dual amplifiers over that required by a similar existing single-channel amplifier. The latest techniques in the use of miniature tubes and components were employed in the manufacture of this equipment. Individual illuminated VU (Volume Unit) meters were provided for each recording and reproducing channel as well as individual gain controls.

A unique problem in the design of this unit arose due to the necessity for providing an overall or master gain control which controlled simultaneously the gain of both channels. This was accomplished through the use of a special dual potentiometer with matched rotational ohmic accuracy in the order of plus or minus 5%.

Provision was made for headphone monitoring from the front panel of the amplifier through the use of specially built Permoflux binaural headphones having an effective response to over 12,000 cycles/sec. These headphones are provided with large foam-rubber ear cushions in order to exclude extraneous noise and to reduce the well-known head fatigue that comes from the use of ordinary earphones. Dual monitor speakers close together on a small panel would not yield any useful binaural effect and might be dangerously confusing for monitoring use. Therefore, in addition to the binaural headphones, a single small monitor speaker is provided behind a flocked screen panel on the front of the amplifier. A unique control is included for this speaker which is so arranged that it is "off" when set at its center position. Maximum volume for one channel is obtained by turning the control to the extreme right, and maximum volume for the other channel, by turning the control to the extreme left.

The amplifier tube lineup for a single amplifier channel consists of two 5879 tubes followed by a dual triode 12AX7, the second half of which is used as an inverter driving a pair of push-pull 6AQ5 tubes. The same amplifier is used for playback as well as recording. A multiple section (shielded between sections) ganged selector switch is used to switch equalizer and gain functions for the dual amplifiers when changing from the record to playback positions. In order to provide freedom from hum in the low-level stages of the amplifiers, direct current is used on the filaments of

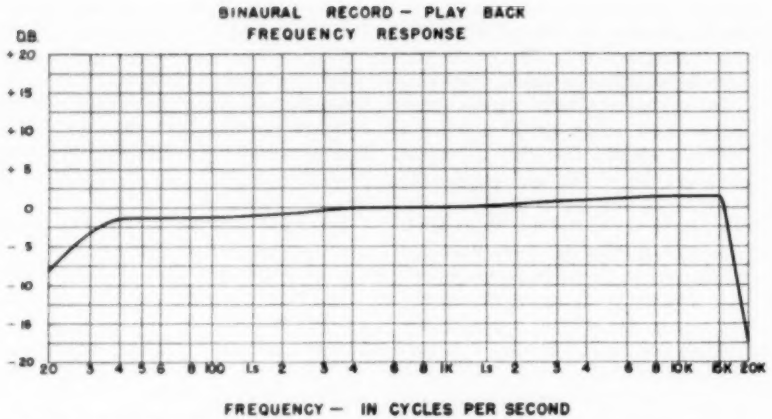

Fig. 2. Overall 15-in./sec tape speed, record-reproduce frequency response.

the input tubes. This is derived from a full-wave selenium rectifier.

The output of the playback system consists of two independent 10-w amplifiers with nominal output impedance of 4 and 16 ohms. A 600-ohm balanced connection is also provided at a line level of +4 dbm for each channel. The system is both pre- and post-equalized in order to achieve a flat response at 15 in./sec recording speed of from 50 cycles to 15 kc ± 2 db (Fig. 2). Both the amplifier unit and the tape transport are provided with facilities which allow operation at $7\frac{1}{2}$ in./sec with a frequency response of from 50 cycles to 7.5 kc ± 2 db.

A signal-to-noise ratio in the order of 50 db is achieved with this equipment. The residual crosstalk between channels is essentially due to low-frequency magnetic coupling below 100 cycles/sec. This crosstalk measures approximately 35 db at 50 cycles and drops with frequency increase until it goes below the tape noise level at a little over 100 cycles/sec.

Calibration Means

In order to assure accurate localizing based upon binaural amplitude comparison, it is desirable that all possible electronic balancing between the two record-reproduce channels be carried out. To this end, a calibration button is provided which inserts a 60-cycle/sec signal simultaneously into the first stages of both amplifier inputs. The channel gain controls may then be individually adjusted to obtain equal VU meter readings. The balanced signals may then be recorded if the tape transport is turned on. When played back, the two 60-cycle signals may again be read on the VU meters and the playback gain controls may then be balanced for the optimum binaural effect.

Commercial Applications

The design of this equipment was aimed at satisfying certain specific commercial applications although it has a definite application to high-fidelity music recording-reproducing, where listening pleasure is desired to be as high as possible. The majority of commercial applications lie in the field of identification of intelligence or information where it is necessary to distinguish between each of many

Fig. 3. Binaural recorder in field use by auto manufacturer testing for noise.

sound sources which may be spread around a given area.

Court recording is one very important and useful application of this equipment. With it, accurate records including differentiation between the various persons in a courtroom may be made. A study by Ray Hirst[6] of monaural court recording has shown that too often court records are at variance with what actually transpired because the court clerk was unable to follow testimony fast enough to accurately transcribe data as it was presented; or because the clerk heard something wrong; or because the clerk simply made a mistake. On one occasion, to our knowledge, it was necessary to reverse the written record due to a stenographic error. Application of this equipment to a Court of Justice would help to improve the carrying out of justice. We have carried out courtroom tests with very effective results and have some excellent demonstration tapes.

Another application of this binaural technique is that used by police and secret-service departments for secret recording of conversations. The standard accepted methods of masking a voice's intelligibility are by the use of continuous tapping noise, by the running of faucet water or by the turning up of a radio for background masking noise. A monaural system cannot distinguish between the masking noise and the intelligence it is desired to detect. A binaural system localizes the attempt at masking and allows the listener to associate direction with the desired sound so that he may achieve intelligibility.

Business, technical or military conference proceedings are a natural for this type of recording since the data may later be transcribed by a stenographer with considerable freedom from error caused by simultaneous talking or masking. A stenographic transcription may be made of two people talking simultaneously since by mental localization the stenographer may concentrate

on the speakers one at a time and then play back the recorded material a second time to get the second speaker. In some recently conducted tests it was found that if two conversations are simultaneously recorded, a capable operator can produce an accurate transcription even when the desired conversation was recorded at a 13-db lower level than the unwanted dialogue.

In radio and motion picture work the second recording channel may be used as a cue or control track for special effects or for recording commentary along with the primary intelligence.

In the laboratory or for field-test work the binaural equipment may be used for recording either binaural or dual-track test data for later careful analysis. Figure 3 shows a binaural recorder in field use by a prominent automobile manufacturer. Note that this setup shows the predecessor to the dual-channel amplifier unit.

The field of audio-visual education utilizes realism as a teaching aid. This portable binaural packaged system readily lends its "third-dimensional" sound reality to assist in critical analysis of band or choir practice, speech classes, dramatics, etc.

Conclusion

1. No appreciable sacrifice in quality from that of a standard $\frac{1}{4}$-in. tape recording system was necessary in these units.

2. The resultant equipment as manufactured is really of a portable nature and is housed in two carrying cases. The amplifier unit weighs but 37 lb, while the tape transport has a weight of 29 lb.

3. From the foregoing data, it is apparent that the design objectives of producing a practical but low-cost commercial binaural record-reproduce magnetic tape equipment were accomplished.

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   J. C. Steinberg, "Pre- and post-equalization of compandor systems";
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Discussion

R. H. Ranger (*Rangertone, Inc.*): Through the courtesy of the Magnecord Company, I have had the privilege of using one of these equipments and I want to say that it is certainly most intriguing to have the opportunity to do so. The particular reason they were anxious to have me try it was to see if we could record a synchronizing signal on this same tape and I can report to you people who are obviously very interested in synchronizing that it is quite feasible. We have recorded the longitudinal track in the center between the other two tracks, so that you can get synchronous operation using this binaural equipment.

I might just add one little reaction that I have had with it and which I confirmed with Dr. Fletcher just yesterday in New York, and that is that not only is it interesting to get two speakers differentiated spatially by this process, but the actual quality of a single speaker, a single person singing, or a single instrument seems to be improved. As Dr. Fletcher said, "I'm too old to figure that out. We'll have to leave that to the younger people."

Anon: Is there any provision in your equipment for playback on one channel while recording on the other?

Mr. Bixler: No, there is not at the present time.

Anon: I have asked that only because there are several applications for which I think that would be a very useful feature. One of them, for instance, is prescored accompaniment in music, while the person practices his solo beside it.

Mr. Bixler: I might say that there is a single multiple contact selector switch which is used to switch both channels simultaneously from record to playback, and that you could do what you suggest if you were to go into the circuit and build in two switches, in place of this single switch along with some other minor modifications.

C. H. Lankester (*United Nations*): In view of the fact, as I understand it, that there is a longitudinal displacement between the record heads, have you found it possible to standardize a positioning of the two heads perfectly accurately, that a binaural recording made on that recorder would play back on another without loss of the binaural effect?

Mr. Bixler: I might say that the speed of the tape actually helps in this respect because it's relatively fast and each wavelength covers quite a bit of tape when you "lay" down the signal. On the other hand, heads are supported in fixed castings so that these same patterns are used in all our machines — it's the standard casting we've been using for years, so that insofar as our equipment is concerned, the location of the heads automatically falls in identically the same position in each and every machine. If there is some minor spacing difference the speed of the tape is sufficiently great so as to swamp that difference out.

John G. Frayne (*Westrex Corp.*): I would like to ask Mr. Bixler if he found it impossible to put the two separate heads in the same head structure because the crosstalk between them would then be undesirable.

Mr. Bixler: Well, yes and no. I imagine if we had tried to put them right alongside of each other we would have had some crosstalk and I looked with interest at Charlie Davis' disclosure in a recent SMPTE *Journal*, but it was a matter of expediency in utilizing present equipment and space location on existing castings on which, as I mentioned, we simply replace the existing record and reproduce monitor heads in standard equipment. Thereby it turns out that the heads are spaced from about one-half to about three-quarters of an inch apart automatically.

Dr. Frayne: What is the separation now between the two half-tracks — between the two components, rather, approximately?

Mr. Bixler: I don't know.

John Boyers (*Magnecord, Inc.*): 50 thousandths of an inch.

Mr. Bixler: Thank you, John.

Dr. Frayne: I believe that with about 50 thousandths separation you might work in the decoupler such as Davis discloses.

Mr. Bixler: Yes, that is if we had heads that were suitable for that type of mounting.

Follow-Focus Device and Camera Blimp for 16mm Professional Camera

By LEE R. RICHARDSON and WILLIAM N. GAISFORD

A novel system of lens focusing, coupled with a synchronized parallax correction cam and focusing viewfinder, is accomplished by the use of planetary gearing to the lenses which also permits fast shifting of lenses without disengaging any cams, gears or footage dials. A plastic camera blimp for the 16mm professional camera and follow-focus mechanism is introduced which reduces the noise level to permit professional sound cinematography.

PRODUCERS OF 16mm television and industrial films are frequently confronted with the problem of photographing a live show, sporting event or other unrehearsed productions which cannot be repeated. In many instances when filming these shows, it is necessary to follow a moving subject which may move toward or away from the camera making it necessary to keep the subject in proper focus and suitably composed on the film. Further, a camera blimp is often required which will reduce the noise level of the camera to permit sound recordings under the most critical sound conditions.

The Raphael G. Wolff Studios of Hollywood, producers of television and commercial productions, were faced with problems similar to the above. After consultation with the Richardson Camera Co., they submitted specifications for a follow-focus device and camera blimp for a Maurer 16–05 Professional Camera equipped with 15-mm *f*/2.5, 25-mm *f*/1.4 and 40-mm *f*/1.4 Eastman Cine Ektar lenses.

The Wolff Studio's specifications called for the development and manufacture of a mechanism to permit follow-focusing of each lens of a multiple-lens turret through their focusing range (3 ft to infinity), provide a simple and efficient means of shifting to another lens of a different focal length at any time, maintain the same focus setting as the preceding lens without interfering with the functions of racking over the camera or threading the film in the camera and enable the operator to keep subjects constantly in sharp focus and suitably composed on the film as the distance between subject and camera position varies even though the subject may move away from or toward the camera in a direct line or at an angle.

Presented on April 25, 1952, at the Society's Convention at Chicago, Ill., by Benjamin Berg for the authors, Lee R. Richardson and William N. Gaisford, Richardson Camera Co., 1065 N. Fairfax Ave., Hollywood 46, Calif.

The requirements of the blimp were to contain the camera and follow-focus mechanism and be constructed of a sound deadening material, be lightweight, and reduce camera noise interference to a level permitting the use of a microphone within 3 ft of the camera.

The Maurer Camera was ideally suited to this project as it comes equipped with a focusing viewfinder with a parallax compensating mechanism.

Design and Construction

A planetary system of gearing was selected as it made possible the functions of keeping the entire gear driving mechanism and viewfinder linkage permanently engaged. The fact that all three lenses are caused to rotate simultaneously in their mounts is not objectionable (Fig. 1).

Each lens was set up in a dividing head and the amount of rotation from the 3-ft mark to the infinity mark were obtained in order to determine the correct gear ratios for synchronizing the lens calibration with the focusing dial and control knob.

The main drive gear consists of a ring gear having both internal and external gear teeth of 48 pitch with annular ball races ground on both faces of the gear and loaded with 480 $\frac{1}{16}$-in. steel balls. Two retaining gear rings are grooved to match the ball races which hold it in place on the front of the camera case. The balls are slightly preloaded to allow the ring gear to rotate with minimum friction and no end play.

Compound gears of proper ratio are driven by the internally cut teeth of the ring gear and are ball-bearing mounted on fixed stud shafts attached to the lens turret plate. These gears in turn mesh with the ring gears attached to the lens focusing barrel.

A gear transfer case transmits motion from the control knob and dial assembly to the externally cut teeth on the ring gear and also to a master cam plate gear housed in the subbase of the camera. These two gears are synchronized with a ratio of one to one.

The master cam plate has three scrolls (Fig. 2) each generated and cut to act upon a cam follower and linkage to the Maurer focusing viewfinder. The cam is spring loaded against the scroll to eliminate backlash.

The viewfinder was modified to function with a minimum of friction and backlash by removing the rack and pinion and replacing the dovetailed slides with ball rollers. As the Maurer viewfinder has two parallax compensating cams, one for the wide-angle lens, 15-mm, and the other for the 25-mm and 40-mm lenses, an adjustable linkage was provided for manually shifting the finder only for the wide-angle lens.

The control knob and dial assembly is one detachable unit and can be mounted on either the left or right side of the camera. A splined coupling permits engaging the control unit to several reading angles.

Operation

A simplified sketch is shown (Fig. 3) which illustrates the basic principle involved in the operation.

Control knob (a) drives gear (b) which in turn rotates internal ring gear (c) causing gears (d, e, f) to rotate, in turn causing gears (g, h, i) to revolve. By proper gear ratios, (g, h, i) rotate lens focusing barrels (j, k, l); thereby, keeping all lenses synchronized in respect to their focusing range from infinity to their nearest focal point. When lock (n) is released from notch in turret plate, and control knob (a) is rotated in either direction, the entire lens-mount assembly attached to the mounting plate (m) will rotate until by-pin (n) drops into next indexing notch in plate (m). All lenses will remain in the same synchronized focus position as the lens mount assembly is shifted from one lens to another because the resistance of the lens-focusing barrels and the gearing will overcome the lighter

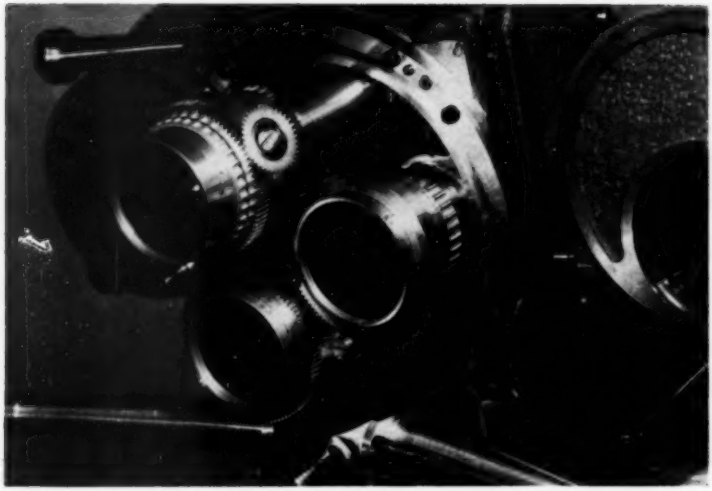


Fig. 1. Planetary gearing system to lenses.

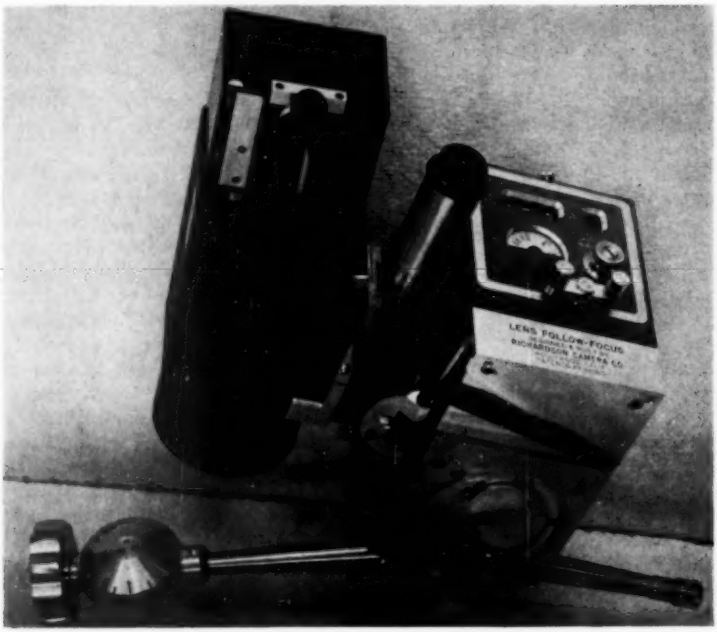


Fig. 2. Master cam plate and viewfinder linkage.

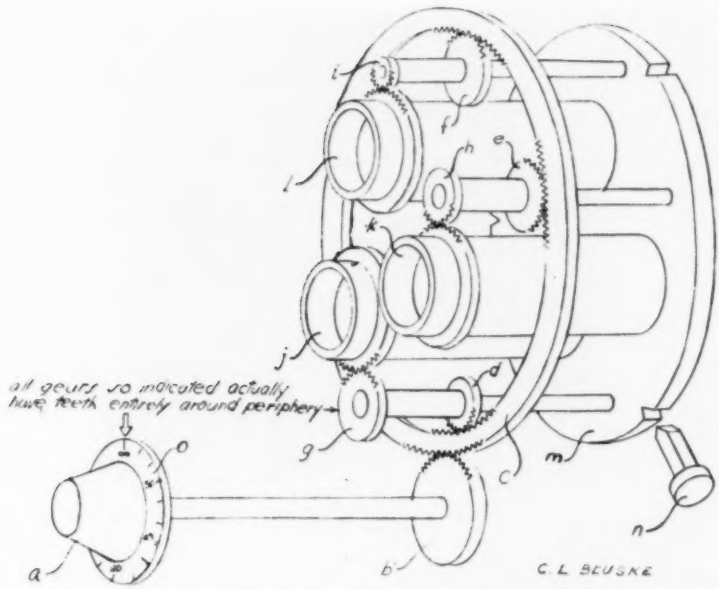


Fig. 3. Schematic drawing of basic principle of planetary gear system.

friction of the mounting plate (m). In shifting from one lens to another, the focus dial (o) will rotate one complete revolution thereby returning to the same distance calibration as the preceding lens.

Example: In the case of a three-lens turret assembly, as illustrated, the gear ratio between the control knob (a) and the internal ring gear (c) is 3 to 1 with three indexing notches on the lens turret plate, one to index each of the three lenses. Focus dial (o) will rotate one complete revolution in shifting lens-mount assembly to next lens. This will allow the use of only one focus dial for all three lenses.

The follow-focus operation incorporates, in addition to the foregoing system of lens focusing, a method of actuating the focusing viewfinder so that the optical elements of the finder sharply focuses the image on its viewing glass in synchronization with the lens focusing of the image on the film.

A stop pin within each lens mount prevents the lenses from rotating beyond their infinity position. This in turn prevents the control knob from being further rotated due to the lens turret plate assembly being locked by the turret locking pin. When a release button is pressed and the control knob turned, the entire lens turret assembly rotates until the next lens is in place, indexed and locked by the turret locking pin. Synchronized with this function is the cam follower which rides out of its cam scroll into an inclined circular groove and drops down into the next cam scroll and is synchronized to the next lens that comes into place.

The linkage from the cam follower to the focusing viewfinder is so constructed to permit racking over the camera for lining up a scene and also

Fig. 4. Three-quarter front view, showing window over camera lens.

for opening the camera door to rethread the film. The viewfinding actuating cam scrolls were generated to their respective lens-focusing distances at the full lens opening. The depth of the field of the lenses allows for normal human error in follow-focusing on a moving subject or when the camera is mounted on a moving platform in relation to a fixed subject.

Camera Blimp Design and Construction

The component sections of the blimp (Figs. 4 and 5) were designed to take advantage of the simplified method of fabrication which is possible with Royalite Plastic, a product of the U.S. Rubber Co.

The base and cover sections are reinforced with an aluminum frame giving additional strength and support for the cover hinge. The interior of the blimp is further soundproofed with Royalite expanded plastic and finished off with a corduroy covering. A rubber grommet, around the edges of the lower part of the blimp, acts as a seal when the cover is closed. The camera mounting base is a steel plate cemented to the inner base of the blimp with a ½-in. thick pad of neoprene sponge rubber between. Guide rails are attached to the base plate to register the camera when installing in the blimp. An aluminum alloy plate is rubber bonded to the bottom of the blimp providing a firm support for the entire unit when mounted on a tripod, camera dolly or platform.

Other main features of the blimp are: (1) an optical glass window which is hinged permitting access to the lenses for setting *f* stops; (2) portholes for observing *f*-stop markings when blimp cover is closed and to check on magazine take-up wheels; (3) external control for turret release button; (4) pilot light to illuminate the interior of the blimp when making lens adjustments, threading, etc.; (5) jeweled indicator lights which show when camera motor is running and pilot light is on; and (6) windows in the rear of blimp for looking through viewfinder, checking shutter openings and footage counter.

Fig. 5. Side view, showing control knob and dial assembly.

Comments

The Richardson Camera Co., when designing the lens-focusing system, were aware of the discrepancies between the three lenses. The problem, however, was not to construct an absolutely accurate focusing system as would be required on precision optical printers but to provide an efficient, simple and quick method of follow-focusing for the cinematographer on action shots.

In focusing a lens on a variable moving subject, it is necessary for the camera man or his assistant to estimate or determine by some visible means the distance between the camera and subject. He must then transfer this information to the lens-focusing control knob or footage dial all of which involves a human function with limited accuracy. The depth of focus of the lens in use is intended to permit a

certain amount of error in the judgment of the operator.

The designers increased the accuracy of the mechanism by calibrating the footage dial to the longest focal length lens used, 40-mm at *f*/1.4 stop. Obviously, where critical focusing is required, the camera is racked over and the subject aligned and focused on a ground glass. This is the most accurate means of focusing and does not depend on footage calibrations engraved on the lens. This means of focusing cannot be used when the subject or camera is in motion.

Conclusions

The follow-focus device was found to be exceedingly efficient as to the accuracy of the mechanism and as to simplicity and time-saving in operation. The knowledge that the lens parallax and distance calibrations are at all times synchronized gives, to the operator, assurance that a sharp focused and composed image is properly recorded on the film.

The lightweight plastic blimp was tested on a sound stage under normal operating conditions and found to be equal in performance to other blimped professional motion picture cameras. In most cases, the front glass was left off and still the camera noise was below the ambient sound noise of the stage making it possible to record dialogue with the microphone within 3 ft of the camera.

Acknowledgments

The authors wish to acknowledge the sponsorship of this project by the Raphael G. Wolff Studios, to Mr. Wolff personally and his camera technicians Art Treutlaar, Gail Papineau and Henry J. Ludwin, all of whom outlined the essential requirements incorporated in this design. Charles L. Bluske, industrial designer, styled the camera blimp. John Roy of the U.S. Rubber Company gave technical advice on fabricating Royalite Plastic material. The Glen Glenn Sound Co. gave its sound stage facilities for testing the performance of the equipment.

Instantaneous Theater Projection Television System

By VICTOR TRAD and RICARDO MUNIZ

A new, inexpensive, instantaneous dual theater projection television system of the Schmidt type is described. A simple control box providing almost instantaneous change-over, in the event of breakdown, and mechanical arrangements facilitating ease of installation and maintenance are discussed.

A STUDY of the needs of the motion picture theater owner and operator made over a period of many years, in connection with the development of this and earlier projection television units, has revealed the need for a thoroughly satisfactory and reliable theater projection television unit which will, at the same time, be substantially lower in cost than those others currently available, and which will be amenable to relatively simple installation techniques, and which can be supplied and kept in adjustment easily by the motion picture projection machine operator. This paper presents some of the technical and operational features of the present Trad theater television unit.

It will be seen that, in this typical installation (Fig. 1), the Trad dual unit rests upon a simple support bracket which, in turn, has been attached to the main balcony support of the theater.

This places the unit in the proper operating position with respect to the theater screen, and also provides maximum accessibility from the balcony of all adjustments and chassis for routine operation and maintenance.

Figure 2 shows how the two chassis, the low-voltage power supply with video amplifier and the high-voltage sweep chassis, are mounted with relation to the projection optical system, and also how accessible the units can be from the balcony without the use of ladders or scaffolding.

The various electronic adjustments are located in the rear of the high-voltage sweep chassis and, once made, need be checked only at infrequent intervals, but which are conveniently accessible from the balcony since they are on the side of the chassis nearest the balcony. It is important to note that this is the only place in the entire installation where any high voltage exists. It is not necessary to have elaborate high-voltage transmission sys-

Presented on April 21, 1952, at the Society's Convention at Chicago, Ill., by Frank H. Riffle for the authors, Victor Trad and Ricardo Muniz, Trad Television Corp., 1001 First Ave., Asbury Park, N.J.

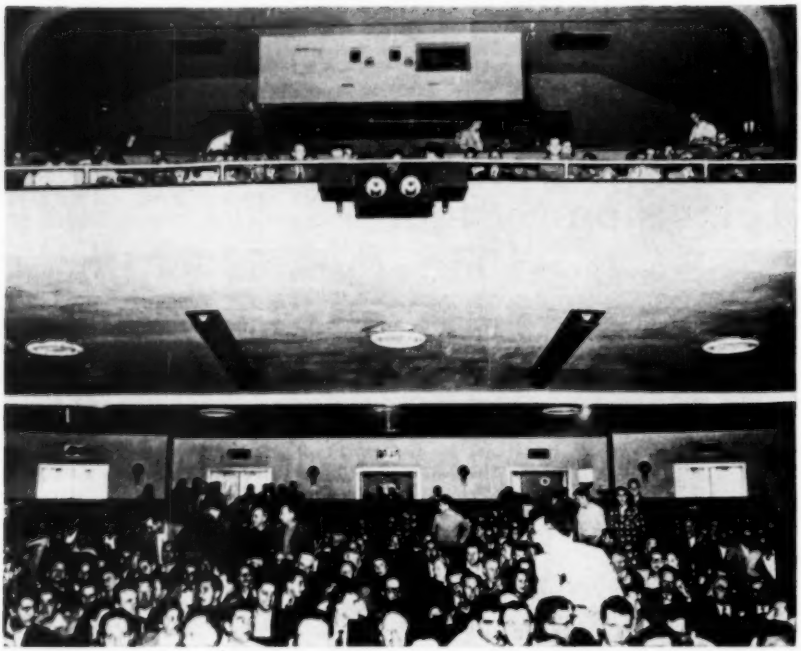


Fig. 1. A theater installation, showing the dual unit mounting.

tems nor protective devices with the Trad theater television unit.

The remote-control unit (Fig. 3) is mounted in the motion picture projection booth near one of the port holes. This remote-control unit provides for the adjustment of contrast, vertical and horizontal hold, and also for the switching from one of the dual units to the other, in the event that any trouble develops in the one in operation. It is here that the operator stations himself and it is these controls alone which he will find it necessary to manipulate during the normal operation of the equipment.

Signals are provided by a monitor, Fig. 4, containing a television receiver and providing video amplification for any remote programs from either microwave link or the coaxial cable. It also provides a third service in that the television receiver which it contains, when connected to a suitable antenna, can provide off-the-air signals from local television broadcasters, should these be required.

Getting back to the main unit, Figs. 5A and 5B show some of the unique features which have resulted from the long practical experience with this type of device. The patented Trad theater projection television unit was designed not only from the standpoint of operational simplicity but also to project the greatest possible amount of light from the projection tube to the screen.

As can be seen, the obstacles to the reflected rays of light have been minimized. It is interesting to note that, with a mirror diameter of 14 in. and a focal length of 6.6 in., the effective

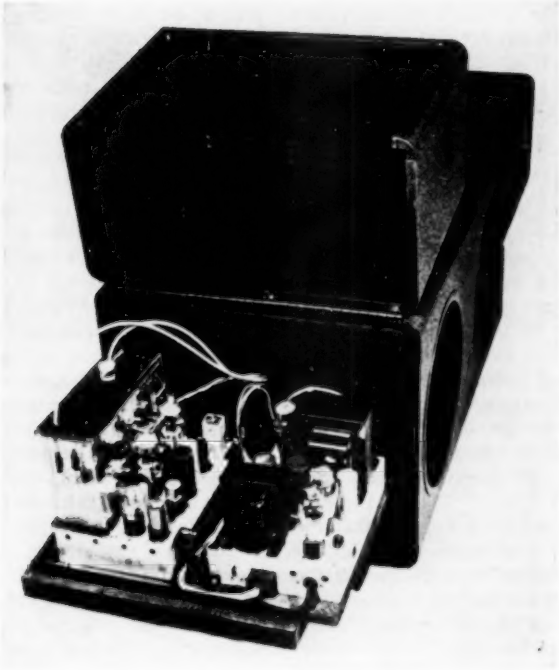


Fig. 2. Close-up of one side of the unit, with protective hood open.

Fig. 3. Remote-control unit.

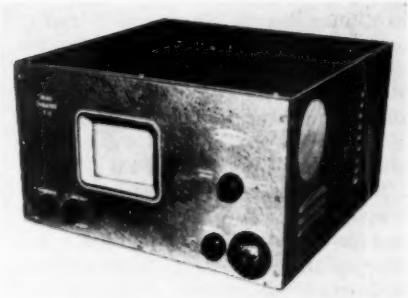


Fig. 4. The monitor.

aperture of the Schmidt optical system used is $f/0.85$.

$$f = \frac{\text{focal length}}{\text{effective diameter}}$$

$$f = \frac{6.6 \text{ in.}}{7.77} = 0.85$$

Light-meter readings taken at the surface of the corrector plate are 160 ft-c. The optical barrel provides for adjustments of vertical and horizontal centering, conveniently accessible from the balcony by swiveling and tilting the barrel, and also for overall top-to-bottom optical focus. The convenience of these adjustments can be readily appreciated by any user who has attempted to make these adjustments on other types of television projection barrels.

It will be noted in Fig. 5A that the vertical and horizontal focus adjustments are accomplished by moving the "dish," which is the curved-front surfaced reflector in the optical barrel, vertically or horizontally by screw-operated mechanisms controlled by the two knobs shown for each direction. Similarly, as in Fig. 5B, the optical focus control has been brought forward by mechanical means so that a simple knob within easy reach of the balcony is all that need be controlled. In installations having the optical system higher than the center of the theater screen it becomes necessary, of course, to tilt the barrels downward in order to throw the picture within the dimensions of the screen. In doing this it is found that, if the optical focusing adjustment is carefully set for the center of the screen, the top and the bottom of the picture are somewhat out of focus.

By adjusting the vertical and horizontal focus adjustment knobs in the rear of the barrel, the picture can be brought into good overall focus without having to tilt the screen. A high degree of "practical" engineering has gone into the Trad barrel as a result of many years of acrobatic hanging by one foot from theater roofs, perching on the top of fire-engine ladders or chinning oneself on a trapeze while using the teeth for adjustment purposes. So, here now is a barrel which doesn't require an acrobat, or any unusual courage or skill to operate. It may be noted in passing that there is symmetry about the center of the dual unit, with the left-hand and right-hand units being mirror images. Each of them independently provides all of the necessary adjustments in equally accessible form.

There are three unique technical features worthy of attention: (1) the high-voltage multiplier supply; (2) the automatic brightness control; and (3) the video amplifier response characteristics. Taking these in order:

The high-voltage tripler operates on a very interesting principle. Figure 6 is a simplified schematic showing the operation of the voltage multipliers. It will be noted that the 6BG6 tube shown in the diagram is one of the horizontal deflection amplifiers which supplies the proper waveform of current to the horizontal deflection coils, which cause the electron beam to scan the face of the cathode-ray tube horizontally during operation. At the end of each horizontal line, the 6BG6 plate current is "cut off" after the incoming horizontal sweep signal drops to zero. A positive pulse of voltage appears at point A as a result of the collapsing field of the horizontal deflection coil (this is a kickback or flyback voltage). These positive pulses are first rectified by V1 which is a diode vacuum tube, and the capacitor C1 is found to be charged to a value very near the peak value of the original pulse. Since the cathode of V1 is connected to the plate of V2 through R1, then C2 will charge up to the same voltage as C1. The charge on C2 is thus added to the oncoming pulse and tube V2 rectifies the sum of these voltages, thus charging capacitor C3 to double the original pulse

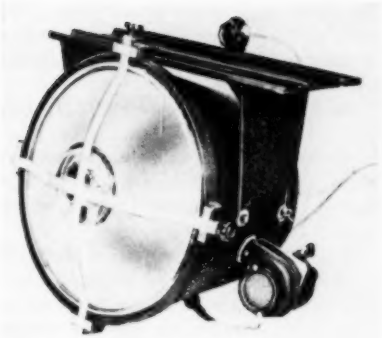


Figure 5A.

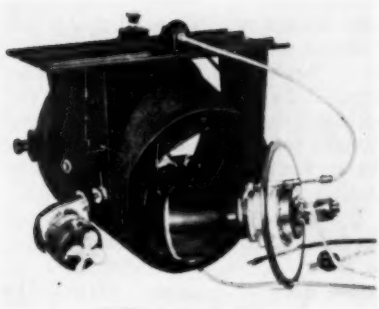


Figure 5B.

Views of the optical barrel.

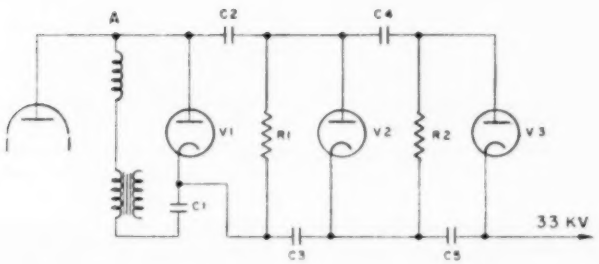


Fig. 6. Simplified diagram of the high-voltage tripler.

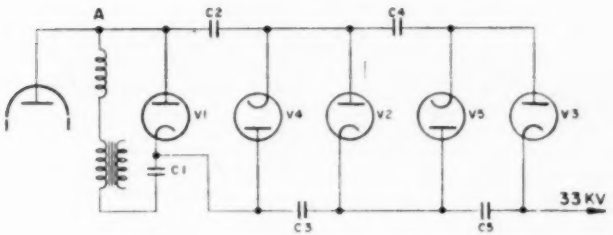


Fig. 7. Simplified diagram showing R1 and R2 replaced by V4 and V5.

voltage. The charge on C4 is added to the already duplicated incoming pulse voltage and V3 rectifies this potential to produce a charge on capacitor C5 of three times the incoming pulse voltage. In the case of this unit, the original pulse voltage is somewhat over 10,000 v so that the output of the voltage multiplier system is approximately 33,000 v.

The type of voltage tripler which was just described is conventional and is used on some other types of television projection devices; however, practical experience has shown that R1 and R2 have such high voltage gradients that it is next to impossible to obtain resistors which will have long life and which will retain resistance stability for a reasonable period. Therefore, in the interests of maximum reliability, these resistors have been replaced in the Trad unit by two additional high-voltage diode rectifier tubes V4 and V5, as shown in Fig. 7, functioning as thermionic resistors and having longer life and greater stability. This was possible because the high voltage across the resistors was direct current; therefore, the vacuum tube could be connected in such a manner that it would present a high impedance to voltages of that polarity while permitting currents in the reverse direction to flow with relative ease. Thus the vacuum tube provides a higher inverse resistance than would have been practical with resistors and still have the advantage of a low impedance in the reverse direction.

Figure 8 shows this circuitry embodied in a completely enclosed plastic housing which provides large margins of safety with respect to arc-over or strike-over of high voltage between the circuit elements and/or ground. The simple and clean design which has been achieved can readily be seen in this high-voltage unit. It is interesting to note also that the five-tube tripler unit can be readily removed from the balance of its circuits for routine maintenance, and that this construction also provides the maximum ease of replacement in the event of any form of failure in the unit.

In Fig. 9, the capacitors C1, C2, C3, C4 and C5 can readily be seen. It should be noted that there are no wires or other protuberances in the high-voltage compartment which would induce breakdowns.

Figure 10 shows the actual circuitry in the high-voltage and sweep chassis. The circuit diagram shown herewith is fairly conventional, but may be worthy of a few words. The composite video signal has had the synchronizing information stripped from it in the associated low-voltage power supply unit, shown in Fig. 11. This synchronizing information is fed into the unit shown and separated into both horizontal and vertical synchronizing pulses by the 6SN7 vacuum tube. A blocking type of oscillator is used for the vertical deflection, whereas a synchro-lock type of horizontal oscillator circuit for maximum synchronizing stability is used for the line frequency. The five-tube tripler, which was explained above, is seen in this diagram, together with its associated circuitry.

Figure 11 is the schematic circuit diagram of the low-voltage power supply and video chassis. It will be noted, a two-stage video amplifier with series and shunt peaking is provided, and that a d-c restorer of conventional design as well as a synchronizing stripper are incorporated on this chassis. The unconventional part of this unit is given on the right-hand side of the d-c restorer tube which, with its associated circuitry shown herewith, rectifies the video signal which appears across the plate load resistor of the second video amplifier stage and supplies this potential to the accelerator grid of the picture tube. This portion of the d-c restorer and its associated circuitry is an automatic brightness control.

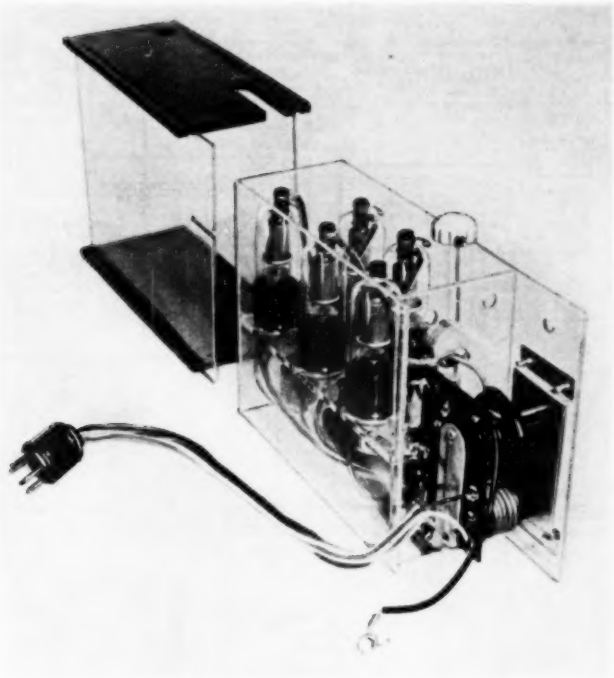


Fig. 8. The tripler assembly, top.

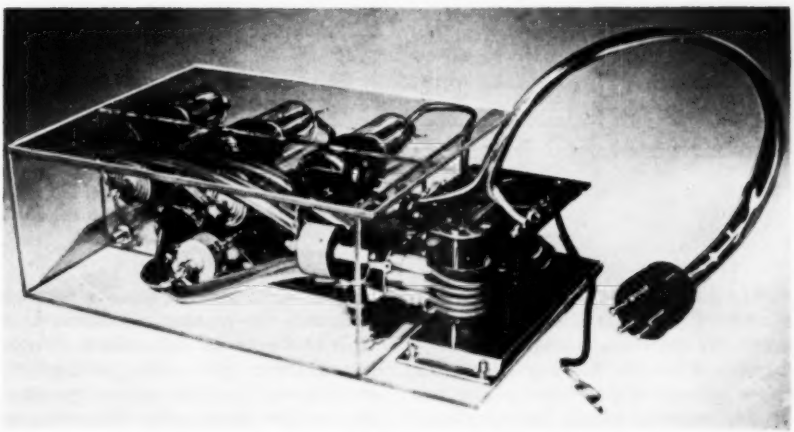


Fig. 9. The tripler assembly, bottom.

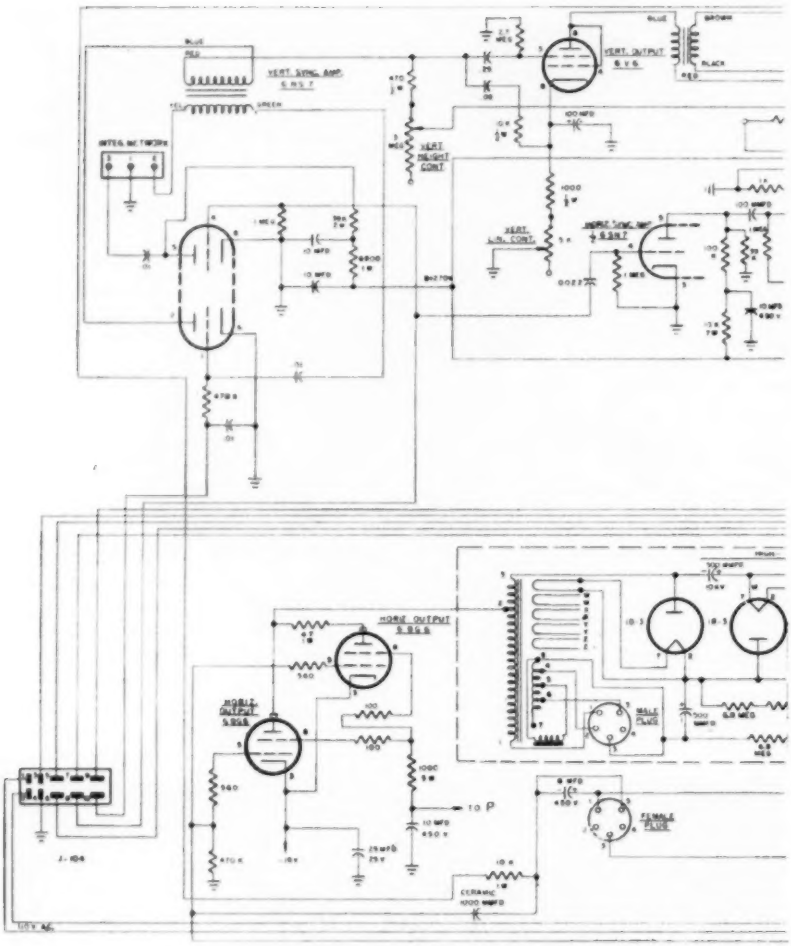
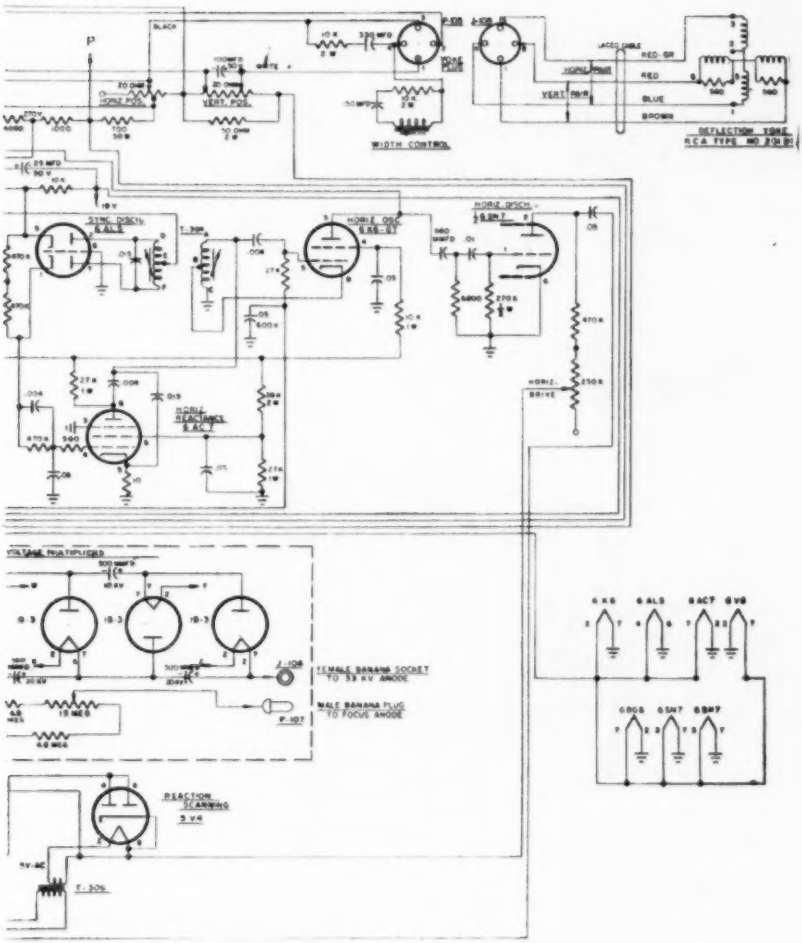


Fig. 10. Circuitry in the high-

The automatic brightness control circuit, Fig. 12, is a means of automatically adjusting brightness on a cathode-ray tube, utilizing the varying plate voltage of the video output tube to adjust automatically the accelerator voltage on the accelerator grid AG of the cathode-ray tube CRT.

This automatic adjustment not only maintains the greatest amount of highlight brilliance at any amount of video signal input, but also prevents the cathode-ray tube from blooming, that is, it prevents abnormal enlargement of picture or raster. This in effect is accomplished by varying the accelerator



voltage and sweep chassis.

voltage upward when the video signal is increased and downward when video signal is decreased.

If the automatic brightness circuit is not used, and a *high fixed voltage* is applied at AG at greatest video signal input, the highlight brightness of the image is high; but upon decreasing the video signal, the brightness of the raster remains the same and the high voltage at HV decreases gradually until the signal is removed. Then the raster "blooms" and becomes "milky," and the high voltage at HV shoots up to its maximum, possibly causing arc-over in the system.

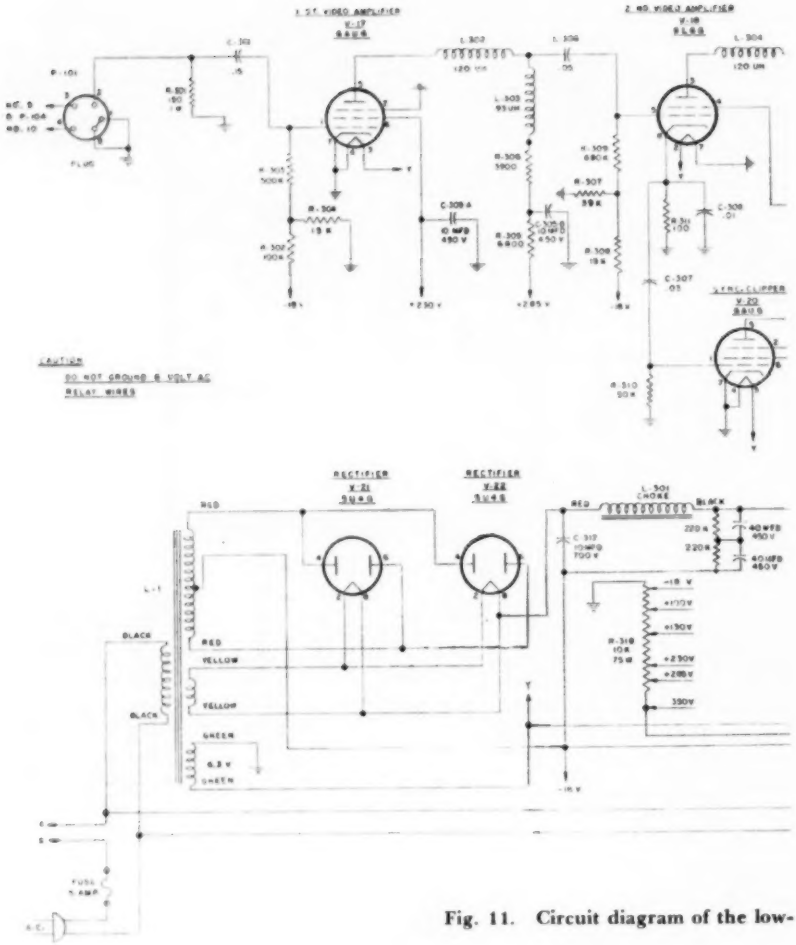
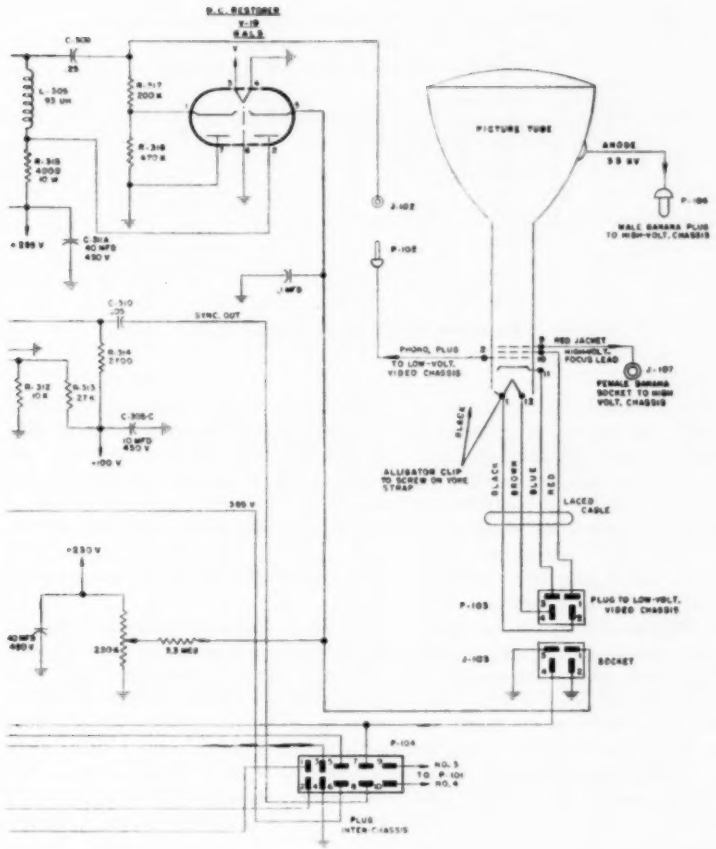


Fig. 11. Circuit diagram of the low-

If, on the other hand, a *low fixed voltage* is applied at AG at the greatest signal input, the highlight brightness is not as high as when the above automatic circuit is used, but the voltage at HV is at a higher point than above. Then, upon decreasing the video signal, the high voltage decreases and the raster brightness remains the same — even after the signal is removed.

From the two conditions described, it is found that, at the high signal input, the picture should be brightest; therefore, the volts at AG should be at a maximum. This keeps voltage at HV at a fixed high-voltage point for greatest possible highlight brightness. As the signal is decreased, the voltage at AG should be decreased, so that the voltage at HV remains very close to its high-



voltage power supply and video chassis.

voltage point, giving the brightest possible picture at this setting. Upon the removal of the signal, the voltage at AG should be brought to its lowest point for proper operation to prevent blooming and the voltage at HV continues to decrease normally — preventing the failures and breakdowns as explained previously. Also, it is readily seen that changing from station to station in this system will cause a decrease of voltage at HV making a very effective safeguard against breakdown.

Potentiometer R, Fig. 12, is a manual adjustment of this proper minimum and is used to compensate for variables in different units which may cause this minimum voltage to be too high, thus causing blooming and the shooting up of the voltage at HV.

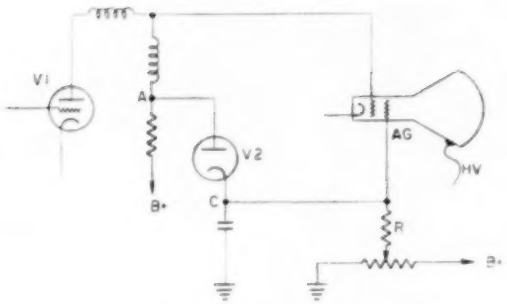


Fig. 12. Automatic brightness control circuit.

The use of a manual brightness control would satisfy the necessary conditions for optimum picture performance, but the addition of another control for the operator to set tends to make the operation of the unit a bit more complicated. The ideal condition is to eliminate the use of manually operated controls and obtain optimum performance settings automatically. The "Trad" automatic brightness control circuit described above accomplishes this with a high degree of efficiency. This system, in addition to being an automatic brightness control, is also an automatic high-voltage regulator keeping the voltage safe at the varying input signal levels.

The graphs in Fig. 13 reveal the action of the automatic brightness control with varying video inputs. Also, shown in Fig. 14 is the interrelationship of average beam current resulting from the effect of the automatic brightness control as the video signal is varied. These graphs were made using a flying-spot scanner picture generator, and varying the output signal voltage, going from no picture, through all the intermediate stages, to a condition of maximum contrast.

One of the important design features of the Trad theater projection television unit is the picture quality, which is the result of critical peaking of the video amplifier circuits to produce a picture of maximum crispness without ringing or smearing. It will be noted from the curve in Fig. 15 that the usable response has been extended to approximately 7 mc, being more than adequate for clear and crisp picture reproduction from either closed-circuit or off-the-air operation.

No less important to the theater owner and operator is the low cost and relative ease of installation of this equipment. Surveys of many theaters were made before design decisions were arrived at, with the result that much less special work need be done in the theater during the installation of this equipment than many others currently offered.

It will be noted, in referring to Fig. 1, that associated dual video amplifier, sweep, and high- and low-voltage supply chassis are installed in a convenient-sized housing which is supported at the fore part of the balcony on a single fabricated bracket which is supplied by Trad. This bracket is mounted by means of bolts through the structural support in the balcony. When mounted in this position, it is out of harm's way and yet is readily accessible for routine maintenance and adjustment.

Figure 16 shows the simplicity of the complete electrical wiring of the system,

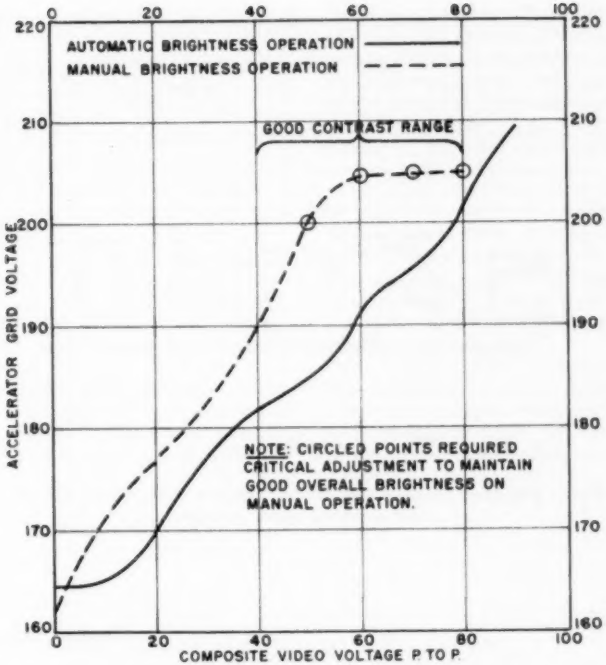


Fig. 13. Accelerator grid voltage vs. composite video voltage, peak to peak.

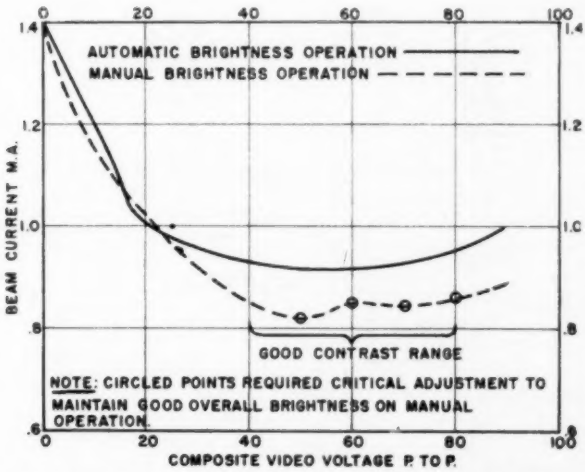


Fig. 14. Average anode beam current vs. composite video voltage, peak to peak.

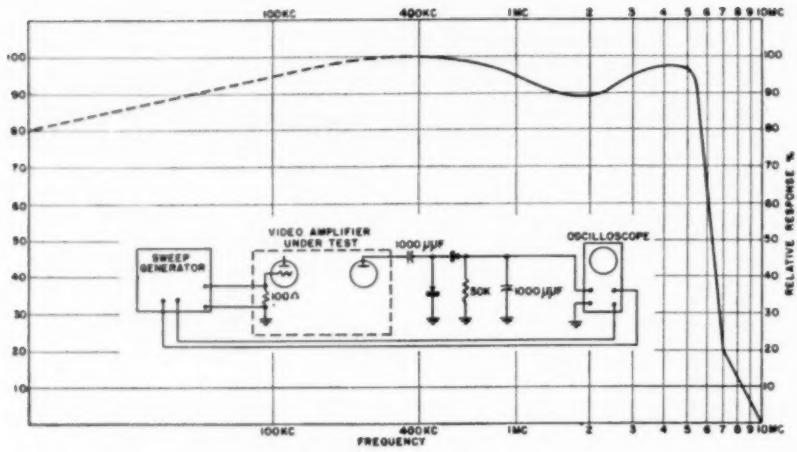
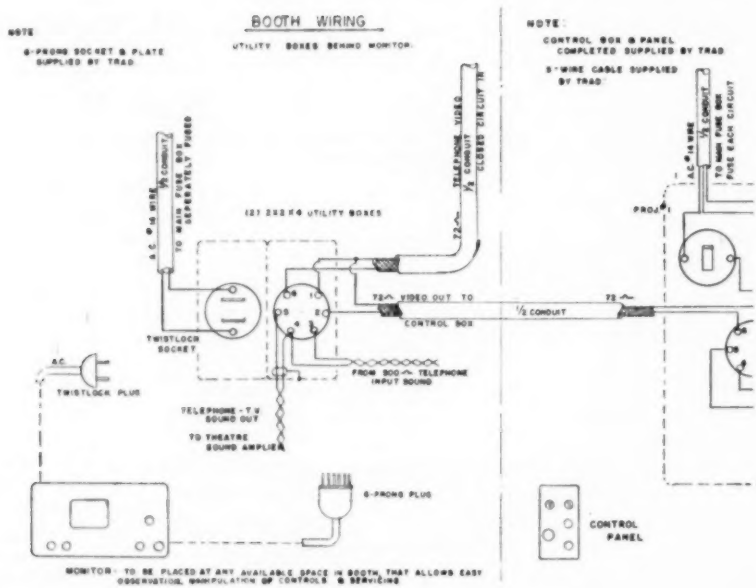


Fig. 15. Video amplifier relative amplitude response with varying input frequency and constant input voltage.

Fig. 16. Complete elec-



necessitating no unusual or complicated wiring.

While it is expected that development work will continue, the unit described is a frozen design and is in production. In conclusion, we have presented herewith the present stage of commercial availability of a simple, low-cost, instantaneous theater television projection system.

Discussion

Robert E. Lewis (*Armour Research Foundation*): How many lumens do you get out of the system?

Frank H. Riffle (*Motiograph, Inc.*): (Mr. Riffle read the paper.) The only actual measurement that we have made is at the corrector plate and it is about 160 foot-candles.

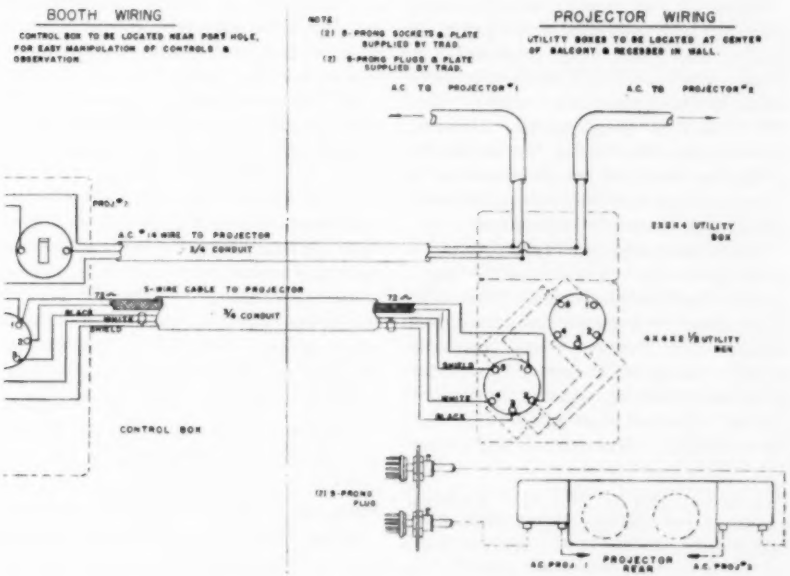
Chauncey L. Greene (*RKO Orpheum Theater, Minneapolis*): Perhaps I am again trying to take in too much territory here, but I would like to see if we can't translate those figures somehow into a screen brightness. Did I understand you that 160 foot-candles of brightness, so to speak, of the face of the tube...?

Mr. Riffle: No, that was at the corrector plate.

Mr. Greene: Now, is there any way of arriving at an approximate ratio between that and the screen brightness for any given picture size, that is, could we, for instance, divide that area into the screen area and apply a factor of loss?

Mr. Riffle: Yes — and in calculating this, we find approximately 0.4 foot-candles of light at the screen, which may appear to be comparatively small; but the brightness of the picture observed is entirely satisfactory.

trical wiring diagram.


BOOTH WIRING
CONTROL BOX TO BE LOCATED NEAR PORT HOLE, FOR EASY MANIPULATION OF CONTROLS & OBSERVATION
NOTE
(2) 5-PRONG SOCKETS & PLATE SUPPLIED BY TRAD
(2) 5-PRONG PLUGS & PLATE SUPPLIED BY TRAD
PROJECTOR WIRING
UTILITY BOXES TO BE LOCATED AT CENTER OF BALCONY & RECESSED IN WALL
A.C. TO PROJECTOR #1
A.C. TO PROJECTOR #2
PROJ #2
A.C. #14 WIRE TO PROJECTOR
3/4 CONDUIT
5-WIRE CABLE TO PROJECTOR
3/4 CONDUIT
BLACK
WHITE
SHIELD
CONTROL BOX
2X4X4 UTILITY BOX
4X4X2 1/8 UTILITY BOX
(2) 5-PRONG PLUG
PROJECTOR REAR
A.C. PROJ #1
A.C. PROJ #2

Theater Television Progress

By NATHAN L. HALPERN

This is a report on theater television developments in terms of the industry, programs, program distribution and the public interest in this new medium.

IN THE DEVELOPMENT of theater television, as in all modern communications media, the engineers have been the pioneers. The records show that as long ago as 1929, technical experiments in large-screen television were being conducted. Many engineers who have been engaged in pioneering this new field, will be interested in hearing of the progress that has been made along trails they blazed.

There are four areas covered in this report: (1) the industrial development of theater television; (2) programs for theater television; (3) the public's reaction to these programs; and (4) the distribution of programs to theaters. Since future engineering developments in this new medium are directly related to the practical economics of theater television, these areas are all important.

Today there are over 75 theaters in 37 cities from coast to coast with large-screen television equipment. This is in comparison to a single television-equipped theater three short years ago. In the past year alone, theater television has increased its seating capacity 600%; the number of cities with installations has risen 300%. Notwithstanding these impressive figures, theater television is only beginning to grow. There are 20,000 theaters to go.

Theater television installations will be made eventually in all motion picture theaters in the country. Although it is off to a fast start, theater television has a long way to go before it can fully realize its great potentials. The harnessing of this form of television by the motion picture industry will offer the public a new and different service. Theater television will become a valuable national resource dedicated to the entertainment and education of the public.

Despite its early stage of growth, there have already been over 300 individual theater presentations of large-screen television programs. While most of these have been news and sports events, there have been a few special entertainment presentations, as well as special government and industry uses of theater television's closed circuits. With few exceptions, the early presentations were experiments, conducted to test public reaction to, and the operation of, theater television. They clearly demonstrated that this new medium satisfied and pleased its audiences. It has been, in fact, the public's acceptance that has caused the further development of theater television.

Theater television has already proved that theater television programs can be

Presented on April 21, 1952, at the Society's Convention at Chicago, Ill., by Nathan L. Halpern, Theatre Network Television, Inc., 515 Madison Ave., New York 22, N.Y.

successful. The conditions necessary for successful special event presentations have been emerging in the past year. Exclusivity, proper promotion and some regularity are all desirable, if not necessary. Matinee sports presentations, which bring new sports audiences into theaters at unprecedented times, require all three of these conditions to be favorable.

The most publicized theater television programs to date were the series of prize fights presented last summer. This series of six fights, presented by Theatre Network Television (TNT), was offered to a public that was unacquainted with the medium, and for this reason the series was presented under adverse circumstances. The boxoffice results were nothing short of startling. The overall average attendance for all theaters on all six TNT fights was 87% of capacity, despite the fact that two of the fights were not top attractions.

This boxoffice average is only a partial indication of the great public interest in these theater television programs. On several of the fights, the numbers of people turned away from boxoffices for lack of seats were much larger than the number of people packed into the theaters. These turn-away crowds were only part of the larger population that would have attended, but for theater television's limited capacity to accommodate the public last summer.

Of importance, too, was the attraction of part of the "lost audience" — non-movie-goers — to the motion picture houses. Theater television proponents had, from the outset, maintained that this new medium would attract new audiences. New audiences added to normal film audiences will expand theater attendance in the years ahead.

It goes without saying that every major medium must pass through an investment period at the start, with operating losses until it has grown sufficiently. The pioneers in home television broadcasting made large-scale investments and sustained high losses for years of operation — losses that ran into millions of dollars for single stations — before they were in the black. The significant thing about theater television is that it has experienced profits on some events from the outset. As compared with television broadcasting, theater television has required relatively small investments and its operating losses have been comparatively small. But before examining the credit side of the ledger, let's take a look at the debits.

The losses incurred in early theater television have not been due to a lack of appeal in its programs or in the medium itself. These relatively small losses were attributable to three factors: (1) the few theaters sustaining the costs of big-time attractions; (2) the pricing policies followed by theatermen; and (3) the absence of a regular, year-round flow of programs and promotion.

Last summer, the TNT series of prize fights was carried by an average of only 12 theaters. In spite of the very small number of theaters which shared relatively high unit costs, it was remarkable how close to break-even these theaters came on most programs. Profits were made on individual fights. Naturally, a larger number of theater installations will reduce individual theater costs and turn losses into profits. And the profits will increase as the number of theater television exhibitors grows.

A prime factor in the difference between profit and loss on theater television events was the initial low admission price policy of exhibitors. At the beginning of the summer fight series, exhibitors were literally giving their products away to see whether people liked them. Some exhibitors seemed to treat theater television as a fight film, to be marketed as a bonus to the feature movie. The cost of theater television presentations added to film exhibition meant exhibitors would incur losses if regular movie admissions were charged. Many chose this course at the start, not realizing that the real

boxoffice pull was theater television, not the movie attraction on such bills. Theaters charged as little as 54¢ net admission for the first several theater televised fights. There was no trouble selling out on nights when film business was ordinarily in the doldrums.

As theatermen saw the public demand and satisfaction, they began to adjust admission prices upward. Moreover, exhibitors began to realize that a theater television event was unique—entirely different from a film which is shown consecutively, or even a live stage show that is repeated throughout its run. A unique, televised event — valuable for the moment — requires special handling and pricing.

By the time of the Robinson-Turpin bout, theaters had adjusted their admission prices to an average well over $2.00. Every theater carrying the fight sold out, evidencing the public's enthusiastic acceptance of this new entertainment medium. The average theater television gross was $5,000 per theater, with seating capacities ranging from 1,100 to 4,000 seats. It became apparent that higher prices for earlier theater television events might have resulted in profits then, too. Moreover, concession sales in theaters boomed, increasing as much as 400% above average.

I would like to give you an idea of theater economics on a successful theater television event at this early period. Perhaps the best way to do this is by taking a specific example: the economics of Theatre X, an actual theater, for one of last summer's TNT fights. Theatre X has 3,300 seats. With a $2.40 gross admission price, and a sellout with 473 standees crammed in, the net receipts, after taxes, were $7,500. Total television costs to the theater (relatively high because of so few theater installations) were $4,000, leaving an operating television profit of $3,500. The deduction of normal house expenses and film distributor costs still left this exhibitor with a whopping profit for a single theater television show. His only regret was that he had to turn away thousands of disappointed people, for lack of room.

The economics of theater television last summer on such individual events clearly pointed up future prospects. If this kind of operating profit could be produced at the outset, with only a handful of theaters, the outlook for programs carried by hundreds and then a thousand or more theaters is fabulous.

The third factor affecting early theater television — the absence of a regular, year-round flow of programs — is due in part to the newness of the medium. The development of entertainment attractions, to go along with outstanding sports events, has preoccupied those of us in theater television these past several months. The entertainment desirable for theater television must, of course, be superior. Even now, theater television is growing closer to the number of outlets necessary to support regularly high-cost presentations and talent.

In the developmental work put into entertainment for theater television recently, talent and craft unions were faced, for the first time, with making decisions on theater television. Most of these unions have recognized the importance of this new field and its gainful employment and compensation potentials for their memberships, as well as its public service aspects. Consequently, their attitudes are becoming progressively more cooperative. Meanwhile, however, time has been consumed in establishing a basis for entertainment in theater television.

It is encouraging to report that there is a wealth of superior talent and entertainment eagerly awaiting the development of theater television. There is no lack of great entertainment, superior to home television and different from movies, for theater television programs. Once the ground rules have been worked out, TNT will launch a schedule of these great programs.

Of paramount importance in limiting the past presentation of theater television

programs has been the unavailability of adequate AT&T facilities to network theaters. The placement of theater television installations necessarily has been made along the routes of the coaxial cable and microwave relay facilities of AT&T. Most theaters in the country cannot be serviced by present telephone company facilities. This situation has forced theater circuits to make multiple installations in fewer cities, thus impeding theater television's early growth. Moreover, the lack of adequate AT&T long lines to theaters located on the cable and relay highways has impaired theater television's ability to develop regular program schedules.

Here is a concrete example of the theater television distribution problem. At the beginning of the year, TNT projected a series of nine programs, to be presented between March 3 and April 13. Considerable work went into the formulation of this series, which included an opera, a Broadway musical, a famous Broadway stage show, a championship fight, championship basketball tournaments, and other sports events. TNT requested AT&T clearances for each program to installed theaters in 23 metropolitan areas at the beginning of February, requiring replies in time for effectuating the schedule.

The total number of long lines clearances for cities requested by TNT of AT&T for these programs was 207; AT&T did not assure clearance of 151; thus 73% of theater television's requirements were not fulfilled for the TNT spring schedule.

The lack of AT&T long lines made this program schedule impractical. Not all theater television requests have met with this fate. However, this experience pointed up acutely that the telephone situation has been a difficult road block to the rapid growth of theater television, and that AT&T has not added sufficient distribution facilities for theater television. The telephone companies have shown increasing understanding of the theater television facilities needs. As a result, it is anticipated that AT&T will free more facilities for theater television, thereby speeding the growth of the medium and increasing its own returns in this field. In this direction, the development of more reasonable telephone charges for theater television should be high on the agenda.

The FCC proceedings on theater television channels will center attention on practical alternatives to these facilities problems. Although postponed in the wake of the hectic activities surrounding the lifting of the television freeze, it is expected that the FCC will reschedule the theater television hearings as soon as possible. Meanwhile, theater television must and will continue to move forward.

Problems on the road to the future are being solved already. Every month the number of theater television installations increases, thus reducing the cost factors for individual theaters. Currently, there are a dozen theater television installations being made, including those of United Paramount Theatres, Warner Brothers Theatres and RKO Theatres. Valuable experience in pricing has been gained already. Programs are being formulated by TNT for production. And it is hopeful that intercity and intracity telephone facilities will become increasingly available at reasonable rates.

Theater television will add fine entertainment of many kinds to its news and sports events. It will provide valuable services in the field of education, as well as specialized closed circuit services to government and industry. It is to be hoped that the growth timetable will not be prolonged by "faint heart" and "Let George do it" attitudes in the industry.

The theater industry needs theater television. The public has already shown that it will go for it. Slowly simmering during the past period, theater television will erupt suddenly with its own formula for success in show business. The road may have obstacles but the future is bright.

Proposed American Standard 16mm Motion Picture Projector for Television

THE INITIAL WORK on this proposal was done by an RMA Subcommittee, TR4.4.2, and a first draft was circulated in May 1950. Need for extensive revision was indicated at the final meeting of TR4.4.2 held in June 1950. At about this time, the present Joint RTMA/SMPTE Committee on Television Film Equipment was organized to replace the RMA Subcommittee.

At the first meeting of the Television Film Equipment Committee, the proposal was again reviewed and revised and a second draft incorporating the desired changes was circulated in September 1950. The extensive nature of the proposal precluded ready agreement, and a third draft, February 1951, and a fourth draft, May 1951, were required before the committee could reach final agreement. The latter was then submitted independently to the RTMA and the SMPTE Standards Committee for further action.

In the RTMA, the proposal TR4-4116 was accepted by TR4, approved for circulation to industry by TREX and released as Standard Proposal #365 in June 1952.

In the SMPTE, the Standards Committee balloted on the question of approving Journal publication of the proposal for a 90-day period of trial and comment and, with but a few exceptions, voted affirmatively. The negative votes were based on the objection that the proposal was more of a procurement or performance specification than a standard defining required dimensional limits for the purpose of aiding interchangeability. With the belief that publication would stimulate worth-while discussion, the Standards Committee gave the necessary approval in June 1952.

Please send comments, in duplicate, to Henry Kogel, Staff Engineer, before December 15, 1952. If no adverse comments are received during the three-month trial period, the proposal will be submitted directly to ASA Sectional Committee PH22 with the recommendation that it be processed as an American Standard.

Proposed American Standard

16mm Motion Picture Projector For Use With Monochrome Television Film Chains Operating on Full-Storage Basis

(Fourth Draft)

PH22.91

1. Scope

1.1 This standard applies only to 16mm motion picture projectors in which the film is advanced intermittently.

1.2 Projectors complying with this standard can be used only with film chains which operate on a full-storage basis.

1.2.1 In full-storage operation illumination from the projector is restricted to the vertical retrace period of the television scan.

1.3 Many of the characteristics of the projector cannot be standardized in specific terms unless the pickup tube used in the film chain is specified. Since the Type 1850-A iconoscope is used almost exclusively at present in film-chain equipment, it has been used as the basis of standardization. If the projector is to be used with any other type of pickup tube, it will be necessary to modify the following paragraphs of this Proposed Standard: 2.1, 2.2, 3.1, 3.2.1, 8.1 and all subparagraphs.

2. Image Dimensions

2.1 An image width of 4½ inches shall be considered standard. (See Paragraph 1.3.)

2.2 The range of focus adjustment shall be sufficient to accommodate widths of image from 3¾ inches to 5 inches. (See Paragraph 1.3.)

2.2.1 The focusing operation shall not displace the picture by more than 1.0% of its width.

3. Projection Lens

3.1 Focal Length. In following sections, for test purposes, the use of a lens having a focal length of approximately 3½ inches will be assumed. (See Paragraph 1.3.)

3.2 Resolution.

3.2.1 Resolution shall be defined and measured in accordance with American Standard Z22.53–1946, except that measurement shall be made with the standard picture width. (See Paragraph 1.3.)

3.2.2 The resolution shall be at least 80 lines per millimeter for the patterns identified as E and D and at least 90 lines per millimeter for all others.

4. Optical Axis

4.1 The projector shall include, or have available as an accessory, a sturdy pedestal. Means shall be provided to place the optical axis (when level) at any required height from 47 to 49 inches from the floor.

4.2 A tilting mechanism shall be included although this need not permit either quick change or change during operation. The range of tilt shall be sufficient to raise or lower by 1 inch an image of standard width, projected by a 3½-inch lens.

4.3 A leveling mechanism capable of rotating the projector about an axis parallel to the optical axis shall be included.

5. Film Gate

5.1 Dimensions. The dimensions of the picture aperture and its location relative to the film shall be in accord with American Standard Z22.8–1950.

5.2 Lateral guiding. At the picture aperture the sprocket hole edge of the film shall be used for lateral guiding. (Note: This is an exception to the recommendations of American Standard Z22.8–1950. For a discussion of the problem involved, see Note 3 of Z22.8.)

NOT APPROVED

Proposed American Standard

16mm Motion Picture Projector For Use With Monochrome Television Film Chains Operating on Full-Storage Basis

(Fourth Draft)

PH22.91

6. Framing Device

6.1 The projector shall have a readily accessible means for positive framing of the picture when the projector is in operation. The range of the framing mechanism shall extend 0.025 inches above and below the standard position measured at the film. The framing device shall be free from creep during operation.

6.2 The method employed for framing shall not change the position of the projected image of the picture aperture by more than 1.0% of the picture width over the full framing range.

7. Picture Stability

7.1 Definition.

7.1.1 The stability of the image depends upon the ability of the projector to locate succeeding frames of film in exactly the same position relative to the picture aperture. Failure to perform this function perfectly results in either jump (vertical instability) or weave (horizontal instability) or both.

7.1.2 Jump and weave shall be measured in terms of the peak-to-peak excursions observed. In each case the result shall be stated as a percentage of picture width.

7.2 Standard.

7.2.1 Jump shall not exceed 0.2% of picture width.

7.2.2 Weave shall not exceed 0.15% of picture width.

7.3 Method of measurement.

7.3.1 Since jump and weave are mechanical characteristics of the projector and are independent of image magnification, it is recommended that both be measured with the greatest magnification that will still give a sufficiently bright image for direct observation.

7.3.2 Jump and weave are usually measured by projecting a Steady Test Film which has an extra perforation in the center of the picture area. This test perforation is made in the same operation in which the sprocket holes are made and it is very precisely located with respect to the sprocket holes. Film of this type may be obtained from the Society of Motion Picture and Television Engineers.

8. Image Illumination

8.1 Intensity. There is no evidence to indicate that any particular significance should be attached either to the peak value of the illumination or to the exact shape of the light pulse as a function of time. Consequently, only the time average value of illumination intensity is standardized. However, in full-storage operation the duration of the light pulse will be approximately 5% of the period of a television field. This short duty cycle is likely to introduce large measurement errors unless certain precautions are observed. (See Paragraph 1.3.)

8.1.1 Definition. The intensity of illumination will be measured in Iconoscope Exposure Units (abbreviated IEU). The IEU is analogous to the foot-candle. Just as foot-candles are measured by a detector having a spectral sensitivity similar to that of the human eye, so are IEU's measured by a detector having a spectral sensitivity similar to that of the Type 1850-A iconoscope. For illumination from a blackbody radiator at a color temperature of 2700 K, a foot-candle

NOT APPROVED

meter and an IEU meter will give identical readings. (See Paragraph 1.3.)

8.1.2 Standard. The intensity of illumination shall be at least IEU'S.* (See Paragraph 1.3.)

8.1.3 Method of measurement.

8.1.3.1 The intensity of illumination shall be measured in the plane of the standard image with the detector in the central area of the image. (See Paragraph 1.3.)

8.1.3.2 The detector shall have a spectral sensitivity matching as closely as possible the spectral sensitivity of the Type 1850-A iconoscope. A sufficiently close approximation is afforded by a Weston Photronic Cell, Model 594RB, equipped with a Corning filter, Type 5-51, 5562. (See Paragraph 1.3.)

8.1.3.3 The meter used with the Photronic Cell shall have a resistance of 20 ohms or less. Because the illumination pulse is of short duration and high peak intensity, the resistance of the meter will cause errors in measurement which increase rapidly with resistance value. For a 20-ohm movement, the error will not exceed 2% over the anticipated range of intensities with the Weston Model 594RB cell. (See Paragraph 1.3.)

8.1.3.4 The combination of meter and cell shall be calibrated against a foot-candle standard using a blackbody source of illumination at 2700 K. (See Paragraph 1.3.)

8.1.4 The source of illumination shall be operated within any applicable ratings established by the manufacturer of the source.

8.2 Control of Intensity. It is probable that means for varying the intensity of illumination will be required for certain types of pickup tube. However, present information is not sufficent to permit the formulation of a standard.

8.3 Uniformity.

8.3.1 Intensity of illumination at any point in the area of the standard image shall be not less than 80% of the maximum intensity of illumination.

8.3.2 Upon replacement of an incandescent projection lamp, if such is used, no readjustment shall be required to achieve this distribution.

8.3.3 The receptive area of the light-sensitive element used for these readings shall have a diameter not greater than 5% of the picture width. No reading shall be taken with the center of the receptive element closer to the edge of the image area than 5% of the picture width.

8.4 Color. Although color of illumination may have significant effects on picture quality, present knowledge is not sufficient to permit the formation of a standard.

8.5 Flicker. Variation from pulse to pulse of the time integral of the illumination falling on any small area of the image may, under some conditions, give rise to visible flicker in the pic-

* Field experience relating illumination in IEU's to satisfactory quality is as yet quite limited. It has not yet been possible to determine the number of IEU's which represent the line of demarcation between satisfactory and unsatisfactory performance.

ture from the film chain. However, present knowledge is not sufficient to permit the formulation of a standard.

8.6 Illumination Period.

8.6.1 Definition.

8.6.1.1 The illumination period is the interval of time in which the instantaneous intensity of illumination in any part of the image area exceeds 10% of the peak instantaneous intensity.

8.6.1.2 The length of the illumination period shall be stated in terms of a percentage of V, where V is the time from the start of one television field to the start of the next field.

8.6.2 Standard. The illumination period shall not exceed 5% of V. This value is dictated by the presently accepted minimum value for the vertical blanking period of the television system, which is 5% of V.

8.6.3 Method of measurement. The illumination period shall be measured by means of a photocell, an amplifier, an oscilloscope and a timing oscillator. The photocell and amplifier must respond without saturation to the peak intensity encountered and the frequency response of the combination shall be down not more than 3 db at 50 kc.

9. Pull-Down Period

9.1 Definition. The pull-down period is the interval of time in which film is moving through the picture aperture.

9.2 Standard. The only restriction to be placed on the pull-down period is that it shall never overlap any part of the illumination period.

9.2.1 If, in a particular mechanism, there is any possibility that the pull-down period may vary in phase relative to the illumination period, then the mechanism shall be designed to allow this phase to change by ± 3% of V from the optimum position with no overlap of the two periods.

9.3 Method of measurement. The existence of overlap may be detected by projecting a test subject consisting of sharply defined white objects on a black background, and inspecting the projected picture for evidence of travel ghost. For this test, film complying with the requirements of American Standard Z22.54–1946 is recommended, although many title strips will be found quite satisfactory.

10. Phasing of Projector Relative to TV Vertical Scan

10.1 For the case of a fixed relation between pull-down and illumination periods:

10.1.1 Means shall be provided for setting the illumination period in any desired phase relative to the 60-cycle frequency which controls the phase of the motor.

10.1.2 Each time the projector is turned on, it shall re-establish this preselected phase relation by fully automatic means in less than 3 seconds.

10.1.3 During operation, the preselected phase relation shall be maintained within ± ½% of V.

10.2 For the case of the illumination period locked to the vertical synchronizing signal and independent of the pull-down period, means shall be provided for insuring compliance with Paragraph 9.2 of this Proposed Standard.

11. Film Capacity and Reel Tension

11.1 The projector shall accommodate reels of any capacity from 400 to 3600 feet which comply with the requirements of Proposed American Standard PH 22.11–1952.

11.2 For any reel size in this range, the take-up tension shall at no time be less than 3 ounces nor greater than 10 ounces (hub diameters less than 4.5 inches excepted).

11.3 For any reel size in this range, the braking mechanism on the feed reel shall not cause a tension greater than 3 ounces (hub diameters less than 4.5 inches excepted).

12. Film Life

12.1 After 100 passages through the projector mechanism, film shall exhibit no evidence of damage either visible in the projected picture or audible in the reproduced sound signal.

12.2 In order that a loop of film may be used in this test, renewal of the splice as many times as may be necessary is permitted.

12.3 The film used in this test may and should be carefully selected and lubricated. The projector is not required to pass this test with film which is in inferior condition.

12.4 Passage of a splice in good condition through the mechanism shall not cause serious disturbance, such as loss of loop, nor shall the mechanism cause excessive damage to the splice.

13. Starting Time

13.1 Definition. The interval between applications of power and the attainment of: (a) synchronous operation of the motor and (b) a flutter content in the sound output which is less than the maximum specified in Paragraph 17.2.

13.2 Standard. The starting time shall not exceed 5 seconds.

14. Film Speed

14.1 The nominal speed of projection shall be 24 frames per second. This shall not be interpreted as excluding the use of a 3-2 mechanism.

15. Stopping Distance

15.1 Definition. The length of film that passes through the film gate after removal of power.

15.2 Standard. The stopping distance shall not exceed 3 feet.

16. Manual Drive

16.1 Some readily accessible means shall be provided for slow-speed manual operation of the mechanism as a check on threading, etc.

17. Sound Scanning System

17.1 Synchronization. The film path distance measured in the direction of travel from the center of the picture aperture to the point to which sound scanning occurs shall be 26 frames ± ½ frame.

17.2 Mechanical stabilization. The rms value of the total (sum of all frequencies) flutter shall not be greater than 0.25% when using a 3000-cycle flutter test film complying with the requirements of American Standard Z22.43–1946. Film splices shall not cause any serious disturbance in sound stabilization.

17.3 Dimensions of Scanning Aperture. In the plane of optimum focus the scanning light beam shall have a maximum width of 0.0005 inches and a length of 0.071 ± 0.001 inches. (Reference for length: American Standard Z22.41–1946.)

17.4 Adjustment of Scanning Beam.

17.4.1 Lateral Adjustment. Means shall be provided for adjusting the lateral position of the scanning beam such that the projector does not reproduce either signal on a buzz-track test film complying with the requirements of American Standard Z22.57–1947.

17.4.2 Azimuth Adjustment.

17.4.2.1 Means shall be provided for adjusting the azimuth of the scanning beam.

17.4.2.2 The azimuth shall be adjusted to secure maximum response using a 7000-cycle test film complying with the requirements of American Standard Z22.42–1946.

17.4.3 Focus Adjustment.

17.4.3.1 Means shall be provided for adjusting the focus of the sound optics to place the plane of optimum focus in coincidence with the emulsion plane.

17.4.3.2 Focus shall be adjusted to secure maximum response using a test film complying with the requirements of American Standard Z22.42–1946.

17.4.3.3 Means shall be provided for rapidly and accurately shifting the plane of optimum focus to coincide with the emulsion position on either side of the film.

17.5 Light Distribution. The light distribution in the scanning aperture shall be sufficiently uniform to produce a signal across a resistive load at the output of the preamplifier which is constant within ± 1.5 db when reproducing a Scanning Beam Uniformity Test Film complying with the requirements of American Standard Z22.80–1950 or Z22.81–1950.

17.6 Exciter Lamp.

17.6.1 The exciter lamp shall be so mounted as to permit rapid replacement.

17.6.2 It is not desirable that uniformity of illumination in the scanning aperture be critically dependent upon exciter lamp position. If this condition exists, means shall be provided for independent horizontal and vertical adjustment of the exciter lamp position.

17.6.3 The exciter lamp shall be a prefocused type unless the lamp holder is a replaceable type equipped with adequate adjustments which can be preset, and a spare lamp holder is provided.

17.6.4 The exciter lamp shall be operated at all times within any applicable ratings established by the manufacturer of the lamp.

18. Sound Amplification System

Any statement of sound-reproduction characteristics must necessarily cover the performance of a preamplifier which is specifically designed as a component of the projector. However, it is not essential that all or even any part of the preamplifier be included in the projector structure. Wherever they are mounted, all parts of the preamplifier should be readily accessible.

18.1 Output Impedance. There shall be available output impedances of 600 and 150 ohms, both to be balanced outputs.

18.2 Output Level.

18.2.1 Standard. The output level shall be −10 dbm.

18.2.2 Method of measurement. This level shall be produced using level test film complying with the requirements of American Standard Z22.45–1946.

18.2.3 A gain normalization control shall be provided having sufficient range to insure compliance with the above standard for any normal combination of exciter lamp, photocell and amplifier tubes.

18.3 Frequency Response.

18.3.1 If the frequency response from film to output is fixed, it shall be flat within ± 1 db from 50 to 6000 cycles per second. If tone controls are provided in the preamplifier, their range of adjustment shall include this response.

18.3.2 Method of measurement. The frequency response shall be determined by means of a multifrequency test film complying with American Standard Z22.44–1946. The amplitude of response shall be measured across a resistance load at the output of the preamplifier. The frequency response shall be determined with standard gain. (See Paragraph 18.2.)

18.4 Distortion. Although it is desirable to state a distortion standard which will cover the photocell as well as the preamplifier, a method of measurement which will accomplish this result is not known. Consequently, the present Standard Proposal covers only distortion in the preamplifier.

18.4.1 Standard. Total harmonic distortion in the preamplifier at standard output level shall not exceed ½% in the range from 50 to 6000 cycles per second.

18.4.2 Method of Measurement. Test signals from an oscillator shall be applied at the photocell input of the preamplifier and distortion shall be measured with a distortion analyzer at the preamplifier output at standard output level.

18.5 Preamplifier Noise Level.

18.5.1 Standard. The noise level of the preamplifier shall be −65 dbm.

18.5.2 Method of measurement. The noise level of the preamplifier shall be measured at standard gain (see Paragraph 18.2), with the projector running, the exciter lamp energized and no light entering the photocell.

18.6 Overall Noise Level.

18.6.1 Standard. The overall noise level shall be −55 dbm.

18.6.2 Method of Measurement. The overall noise level shall be measured at standard gain (see Paragraph 18.2), with the projector running, the exciter lamp energized and no film in the machine.

Appendix A

The gate of the projector should be designed to provide easy access to aperture and rails for thorough and effective cleaning and inspection.

NOT APPROVED

Appendix B

The American Standards listed below have been cited in the present Proposed Standard. Copies of any of the reference standards may be obtained from the American Standards Association, 70 East 45 Street, New York 17, New York.

1. Z22.8–1950
   Location and Size of Picture Aperture of 16mm Motion Picture Projectors.
2. PH22.11–1952
   16mm Motion Picture Projection Reels.
3. PH22.16
   Emulsion and Sound Record Positions in Projector for Direct Front Projection of 16mm Sound Motion Picture Film.
4. Z22.41–1946
   Sound Records and Scanning Area of 16mm Sound Motion Picture Prints.
5. Z22.42–1946
   Sound-Focusing Test Films for 16mm Sound Motion Picture Projection Equipment.
6. Z22.43–1946
   3000-Cycle Flutter Test Film for 16mm Sound Motion Picture Projectors.
7. Z22.44–1946
   Multi-Frequency Test Film for Field Testing 16mm Sound Motion Picture Projection Equipment.
8. Z22.45–1946
   400-Cycle Signal Level Test Film for 16mm Sound Motion Picture Projection Equipment.
9. Z22.53–1946
   Method of Determining Resolving Power of 16mm Motion Picture Projection Lenses.
10. Z22.54–1946
    Freedom from Travel Ghost in 16mm Motion Picture Sound Reproducers.
11. Z22.57–1947
    Buzz-Track Test Film for 16mm Motion Picture Sound Reproducers.
12. Z22.80–1950
    Scanning-Beam Uniformity Test Film for 16mm Motion Picture Sound Reproducers (Laboratory Type).
13. Z22.81–1950
    Scanning-Beam Uniformity Test Film for 16mm Motion Picture Sound Reproducers (Service Type).

Proposed Amendments to the Bylaws

TWO SUGGESTED AMENDMENTS to the Bylaws of the Society are presented here, with the Board of Governors' reasons for proposing that they be adopted. They represent the first formal result of an official study of organization and operating practices of SMPTE started last January at the Board's request and are intended to state clearly two matters of importance. The first recites the long established policy of the Society respecting the voluntary nature of Standards and Recommendations developed within SMPTE engineering committees. The second sets down, of legal necessity, a newly drawn provision for disposition of the Society's assets in the unlikely event of dissolution.

For these amendments to become official they must be processed as outlined in Bylaw XIII last published on page 348 of the *Journal* for April this year. The Board of Governors initiated the recommendation during its meeting in New York on July 17. Publication here is also required and next comes consideration by the voting members during the regular meeting of the Society which is held annually during the fall convention. This year it will occur at 3 P.M. Monday afternoon, October 6, just preceding the first technical session of the Society's 72d Convention at the Hotel Statler in Washington, D.C.

Voluntary Standards

As a part of his regular quarterly report to the Board of Governors, Fred T. Bowditch, Engineering Vice-President, stated his belief that although the members of the Society knew that American Standards for which the Society serves as sponsor, and other formal Recommendations published by the Society, were voluntary, and that their existence did not preclude members or nonmembers from manufacturing and selling products not conforming to the Standards, it would be advisable to incorporate a provision to that effect in the Bylaws of the Society. The Board was in agreement and passed a Resolution proposing adoption of the following:

BYLAW XIV

Standards and Recommendations

Sec. 1. American Standards sponsored by the Society and the Society's Recommendations are proposed and adopted in the public interest and are designed to eliminate misunderstanding between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for its particular need. Existence of such a Standard or Recommendation does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the Standard or Recommendation.

Disposition of Assets

Herbert Barnett, Executive Vice-President, who served as Chairman in the absence of President Peter Mole, stated that in his opinion it would be advisable to provide in the Bylaws for disposition of the Society's assets in case of dissolution. After extended discussion, the Board voted in favor of such a provision, approving unanimously the following proposed amendment:

BYLAW XV

Disposition of Assets and Dissolution

Sec. 1. Upon the dissolution of the Society and after payment of all indebtedness of the Society, the funds, investments and other assets of the Society shall be given and transferred to some other nonprofit organization having objects similar to those of the Society. The selection of such other organization shall be made by the Board of Governors either at a regular meeting of said Board of Governors or at a special meeting of said Board called for the purpose of selecting such an organization.

72d Semiannual Convention

This Fall's Convention at the Hotel Statler, Washington, D.C., October 6–10, will be a blaze of highlights with very strong base lighting of the fields of Society interest, for despite the heat, humidity, politics and other summer distractions all the plans keep building.

Program Chairman Joe Aiken has lined up the scores of papers into some 14 sessions to release the Advance Notice of the Convention to be mailed to all members in the Western Hemisphere on August 6. This carries the tear-off postal for reserving hotel rooms. If you have not made reservations and need a copy of the postal for convenience, ask Society headquarters for one. The Advance Notice also has the abstract of the technical papers sessions.

Although the sessions are all arranged, occasionally authors have to withdraw a paper—so if you have a special paper suddenly cleared, it might still be fitted into the Final Program. If so, write air mail or wire: Joseph E. Aiken, 116 N. Galveston St., Arlington, Va.

One large and special part of the technical program will be the first International Symposium on High-Speed Photography which is planned as fully the equivalent of two days of sessions, some of them concurrent with sessions on topics from other parts of the Society's interest. John H. Waddel is Chairman for this symposium.

16mm equipment maintenance is the subject of another session being developed by R. T. Van Niman who will welcome all who come bearing manuscripts, ideas or possibly other contributions to this symposium and discussion.

A session on magnetic striping has been organized by Glenn Dimmick. This session contains four formal papers but there is still allowable room for anyone who feels that he can or should make a contribution to this subject.

Highlights that can now be mentioned are: descriptions of recording television pictures on magnetic tape presentation of the Signal Corps' Mobile Television System; report on the National Television Systems Committee accomplishments in color television; laboratory session papers on high-speed processing, rapid drying, and butt-weld splicing.

Bill Kunzmann, the Society's Convention Vice-President, gave the Board of Governors a complete report in July, covering all the arrangements and commitments made for the Washington convention. Bill was in Washington in late May and at that time held an organizational meeting which resulted in our having the following roster of folks who will put over the operation of the convention:

Program Chairman — Joseph E. Aiken
International Symposium on High-Speed Photography — John H. Waddell
Papers Committee — Chairman, Edward S. Seeley — Vice-Chairmen, Joseph E. Aiken, Fred G. Albin, Geo. W. Colburn, Gerald G. Graham, W. H. Rivers and John H. Waddell
Local Arrangements — Joseph E. Aiken
Hotel Reservations and Transportation — Henry Fisher
Luncheon and Banquet — Nathan D. Golden
Membership and Subscriptions — Ray Gallo, assisted by G. J. Badgley
Motion Pictures — James Frank, Jr., assisted by John V. Waller
Naval Ordnance Laboratory Session Arrangements — Max Beard
Projection, 35mm and 16mm — Carl R. Markwith and Henry F. Heidegger, assisted by John V. Waller, and members Local 224, I.A.T.S.E.
Public Address and Recording — J. Clinton Greenfield
Publicity — Harold Desfor, assisted by Leonard Bidwell and J. A. Moses
Registration and Information — Keith B. Lewis, assisted by P. M. Cowett, Fred W. Garretson, Max Kerr, J. A. Moses and Howland Pike
Television — Col. C. S. Stodter, R. N. Harmon and W. P. Dutton
Ladies Reception and Registration — Mrs. N. D. Golden and Mrs. J. E. Aiken, Cohostesses

Engineering Activities

Development of American Standards

Motion picture — and related television — standards in the United States are today developed primarily by SMPTE Engineering Committees. While that is widespread knowledge, the steps in that development are probably not so well known. A brief review of the procedures used in producing American Standards in cinematography is therefore given below. It is hoped that an awareness of these procedures will make for an even wider participation in standards activity, which can only serve to improve the quality and observance of these standards.

1. Request for Standard: The need for a standard may be brought to the attention of the Society's Engineering Vice-President by anyone interested: manufacturer, consumer, Society member, government body, etc.

2. Drafting the Standard: The Engineering Vice-President estimates the general value of the request and refers the project to the appropriate Engineering Committee. The Committee, a broad representative group of some phase of the motion picture industry, makes any required studies or surveys and prepares a draft standard.

3. Reviewing the Standard: After the Engineering Committee approves its "final" draft, the proposed standard goes through an extensive review to assure the kind of acceptance required under our system of voluntary standards.

a. Standards Committee: The SMPTE Standards Committee is composed, in the main, of the chairmen of the engineering committees. This first review of the proposal is therefore designed to achieve agreement within the Society. Approval by the Standards Committee is required before the draft can be published in the *Journal*.

b. Journal Publication: Publication of the draft for some stated period (usually 3 months) for trial and comment provides all *Journal* readers an opportunity to study and criticize the proposal.

c. ASA Sectional Committee, PH22: If no adverse comments have been received during the trial period, the Engineering Vice-President transmits the proposed standard to PH22 with a recommendation that it be processed as an American Standard. PH22 is composed of representatives from every group having a vital interest in cinematographic standards. Approval by PH22 generally indicates that the technical content of the standard is in good order.

d. SMPTE Board of Governors: After approval, PH22 returns the standard to the Society for sponsor approval which is conferred by Board of Governors action.

e. Photographic Standards Correlating Committee: At this point and on behalf of the Board of Governors, the Executive Secretary formally transmits the proposed standard to the Director of the ASA, concluding Society action on that particular standard. The Correlating Committee is an ASA body formed to integrate the standards activity of all elements of the photographic industry and so reviews all photographic standards proposals before final approval is granted.

4. American Standard: A proposed standard acquires the stamp "American Standard" upon approval of the ASA Standards Council, the final board of review. This group has representatives from each ASA Member Body and thus provides a clearing house for vast numbers of standards from widely diversified industries. Publication in the SMPTE *Journal* completes the lengthy journey from request to American Standard.

It should be noted that any group may submit a proposed standard to PH22 for processing as an American Standard and this the Motion Picture Research Council has done in quite a few instances. This in no way changes the ensuing procedure since the SMPTE as sponsor of PH22 must review the proposal in order to authorize the required sponsor approval.

Your attention is also drawn to the fact that the technical committees of the Society are not closed corporations. A request to have your organization represented on one or several engineering committees would be welcomed by the Engineering Vice-President and would receive serious consideration — *Henry Kogel*, Staff Engineer.

Canadian Standards Association

The Canadian Standards Association was established by Dominion charter granted in 1919. As a result of experience gained during several years of operation and particularly during the war years the charter was amended in 1944 to embrace a broader field of operation as outlined below:

(a) To provide, originate and furnish Canadian standards of any nature whatsoever which are in the interests of producers and users; to coordinate the efforts of producers and users toward the improvement and standardization of materials, processes and related matters; to provide systematic means by which organizations interested in standardization work may cooperate in establishing and promoting Canadian standards to the end that duplication of work and the promulgation of conflicting standards may be avoided.

(b) To serve as a clearing house for information on standardization work in Canada and foreign countries; to further the standardization movement as a means of advancing the national economy, and to promote a knowledge of, and the use of, approved Canadian standards both in Canada and foreign countries; to act as an authoritative Canadian channel in international cooperation in standardization work.

(c) To register in the name of the Association, and to hold, own, use and operate any and all trade marks, proof, letter or device and to enforce and protect the use of such marks, proofs, letters or devices and to oppose any proceedings or applications which may seem calculated directly or indirectly to prejudice the interests of the Association.

Committee Organization

The Canadian Standards Association has close contact, by direct representation, with the following classifications of interest: Manufacturers, Departments of the Dominion Government, Provincial Governments, Public Utilities, Educational Institutions, Professional Bodies, Labour Organizations, Purchasing Departments, Insurance Interests.

From the various classifications of interest a series of Divisions has been established covering such representative fields as Textiles, Agriculture, Pulp and Paper, Steel Construction, Electrical Engineering, etc. From these Divisions a Main Committee is drawn, each member serving for a period of three years and eligible for further service at the discretion of the nominating interests. This is the governing body of the C.S.A.

From the Main Committee, members are elected by the Divisions to form the Executive Committee which is the administrative body of the Association.

Sectional committees are appointed by the Divisions, each sectional committee consisting of from 10 to 30 members, representing the best available knowledge and experience in their respective fields. Their responsibility is to supervise the work of standardization with the scope of each division. They are responsible for the approval of specifications, which have been developed by their working committees and for submitting same to the Executive Committee for final approval and publication.

When a request is received to produce a standard specification for any commodity, it is referred to the division interested, for consideration and recommendation to the Executive Committee for action. Should there appear to be a reasonable demand for the standard in question and sufficient information available to assure satisfactory completion of the work, authority will be given to the division by the Executive Committee to proceed with the preparation of a standard.

If sufficient information appears to be lacking, and scientific investigation is considered necessary, proposals will be made to a recognized research body, such as the National Research Council, to conduct tests or make investigations in order to provide needed information that will permit an authoritative standard to be prepared.

These Working Committees consist of a variable number of members ranging from five or six to as high as thirty or more, depending on the nature of the work to be done.

As work progresses, a draft specification is prepared and subsequently discussed

at meetings of the Working Committee. Verbal recommendations for revision, and those received from members unable to attend or interests not desiring direct representation, receive full consideration. This usually necessitates the preparation of several draft specifications, requiring considerable time before a proposed standard is considered ready for publication.

Every effort is made, not only to assure full representation of the views of all interests, but to tap every available source of information, both foreign and domestic. Accordingly, when a standard is published, it represents, as far as possible, the best available authority consistent with general knowledge and local conditions.

Approvals Division

The C.S.A. has had a certification procedure in effect for many years and the C.S.A. label is recognized throughout Canada as a symbol of assurance that electrical equipment and devices are reasonably free from fire and accident hazards. This Approval Service, which now insures compliance with safety and performance standards can be extended, as and when industry becomes convinced that certification, on a quality basis, is beneficial to the producer as well as to the consumer. The details of the procedure will be developed in collaboration with appropriate producer and consumer interests as required.

C.S.A. Standards

An important feature of C.S.A. standards, in line with British and American standardizing practice, is that they are "voluntary" standards. As such, they serve as recommendations to industry and may or may not be adhered to by the manufacturers concerned.

Such standards may, on the other hand, become mandatory by adoption by a government department having legal authority to enforce their requirements in the matters of governmental purchases, when the standards concern specific materials or products. The Association has published approximately 200 such standards — thus far limited to the various sections of engineering.

Photography

The C.S.A. Sectional Committee on Photography was organized in 1948 with Dr. L. E. Howlett of the National Research Council as chairman. Three specification committees are at work in this field at the present time:

Z7.1 — Motion Picture Photography;
Z7.2 — Still Photography; and
Z7.3 — Survey Photography.

Committee Z7.1 has completed a review of all basic A.S.A. and B.S.I. motion picture standards and some 43 have been published by the C.S.A. A specification for an industrial and educational model 16mm projector is now in the final draft stage. Members of this committee with their affiliations are:

A. H. Simmons (*Secretary*), Gevaert (Canada) Limited, Ottawa
Harold Walker, Dominion Sound Equipments Limited, Montreal
Don Spring, Canadian Kodak Sales Ltd., Toronto
John Gerald, Ansco of Canada Ltd., Toronto
Sqn. Ldr. N. Drolet, Armed Services, Ottawa
Gordon Adamson, National Film Society, Ottawa
Gaudry DeLisle, Department of Education, Quebec City
H. Goldin, Consulting Engineer, Toronto
M. Metzger, Associated Screen News Ltd., Montreal
Arthur Elsey, Canadian Industries Ltd., Montreal
P. D. Carmen, National Research Council, Ottawa
A. J. Pauley, The Odeon Theatres (Canada) Ltd., Toronto
F. T. Myles, R.C.A. Victor Co. Ltd., Montreal
John Young, Benograph, Montreal
G. Graham (*Chairman*), National Film Board, Ottawa

Editor's Note: This report was kindly prepared by Gerry Graham, Director of Technical Operations, National Film Board of Canada, upon our request for help in adding to the series of brief articles describing organizations which SMPTE members wish to know more about. Previous stories have been about the American Documentation Institute, the Biological Photographic Association, and the University Film Producers Association. Your suggestions for subjects or possible contributors for other articles are welcome.

New Members

The following members have been added to the Society's rolls since those last published. The designations of grades are the same as those used in the 1952 MEMBERSHIP DIRECTORY.

Honorary (**H**) Fellow (**F**) Active (**M**) Associate (**A**) Student (**S**)

Baggs, Sgt. David A., Officer in Charge of Motion Picture Processing, U.S. Air Force. **Mail:** 2413 Girard Pl., N.E., Washington 18, D.C. (**A**)

Barr, William J., Camera Technician, Warner Bros. **Mail:** 5537 Costello Ave., Van Nuys, Calif. (**A**)

Benedict, Joel A., Director, Bureau of Audio-Visual Aids, Arizona State College. **Mail:** 929 McAllister, Tempe, Ariz. (**M**)

Beyer, Walter, Motion Picture Engineer, Bell & Howell Co. **Mail:** 7455 N. Greenview Ave., Chicago 26, Ill. (**A**)

Board, Cornelius Z., Arizona State College. **Mail:** Route 1, Scottsdale, Ariz. (**S**)

Bonner, Ray S., Recording Engineer, Gallagher Films, Inc. **Mail:** 5062 N. 54 St., Milwaukee, Wis. (**A**)

Cackowski, John, University of California. **Mail:** 5324 Monroe St., Los Angeles 38, Calif. (**S**)

Chaffee, William H., President, Model Builders, Inc., 5300 W. 63 St., Chicago 38, Ill. (**M**)

Clark, Dick H., Student and Teaching Assistant, University of California, Motion Picture Dept., 405 Hilgard, Los Angeles, Calif. (**A**)

Cooper, Richard J. G., Technical Officer, Dept. of National Defense, No. 11 Supply Depot, R.C.A.F., Calgary, Alberta, Canada. (**A**)

Copeman, Robert A., Motion Picture Service Engineer, Box 2140, Salisbury, Southern Rhodesia. (**A**)

Curran, Charles W., Motion Picture Producer, Times Square Productions, Inc. **Mail:** 145 W. 45 St., New York 36, N.Y. (**M**)

Damm, Roger, American Television Institute. **Mail:** 7408 Warren Ave., Forest Park, Ill. (**S**)

Donovan, Lewis N., Chief Radio Operator, Alberta Government, Dept. of Lands & Forests. **Mail:** 10028—105 St., Edmonton, Alberta, Canada. (**A**)

Dunn, Reginald S., Laboratory Technician, Color Reproduction Co. **Mail:** 4841 Stansbury Ave., Sherman Oaks, Calif. (**A**)

Edwards, Marvin J., Arizona State College. **Mail:** 6225 N. 47 Ave., Glendale, Ariz. (**S**)

Fernandez, Victor M., National Airlines, Inc. **Mail:** 13 y Ave. Primera, Ampl. de Almendares, Havana, Cuba. (**A**)

Gerard, Morton T., Jr., Motion Picture Photographer, North American Aviation, Inc. **Mail:** 2457 Ashland Ave., Santa Monica, Calif. (**A**)

Gilkeson, David C., Project Engineer (Optics), Wollensak Optical Co., 850 Hudson Ave., Rochester 21, N.Y. (**M**)

Hall, Carlisle D., Laboratory Manager, Ansco. **Mail:** 5506 N. Winthrop Ave., Chicago 40, Ill. (**M**)

Herzig, Leonard A., President, Sound Engineer, Prestoseal Manufacturing Corp. **Mail:** 87-11—35 Ave., Jackson Heights, N.Y. (**M**)

Hine, Sheldon, Technical and Engineering Photography, 2538 Joan St., Fort Wayne, Ind. (**A**)

Holblinger, Anton, Sound Engineer, Photo-Magnetic Sound Studio, Inc. **Mail:** 35 Princeton St., Valley Stream, L.I., N.Y. (**M**)

Jennings, Forrest, Laboratory Technician, Color Reproduction Co. **Mail:** 2363 Hermits Glen, Hollywood 46, Calif. (**A**)

Johnson, Culver, Engineer, Culver Johnson Research, 871 Seventh Ave., New York, N.Y. (**M**)

Jones, Almon, U.S. Naval Photographic Center. **Mail:** 3130 Knox St., S.E., Washington, D.C. (**A**)

Klein, Gerard, New York University. **Mail:** 205 Beach 81 St., Rockaway Beach, N.Y. (**S**)

Marcus, Wil, Motion Picture Producer, Loucks & Norling Studios, 245 W. 55 St., New York 19, N.Y. (**M**)

Meunier, Jean L., President, Institut Teccart, Inc., 3155 Hochelaga St., Montreal 4, Canada. (**A**)

Mikrut, Stanley M., Motion Picture Laboratory Technician, Coronet Films. **Mail:** 2460 Winona St., Chicago 25, Ill. (**A**)

Mims, Charles W., Mechanical Engineer, Technicolor Motion Picture Corp. **Mail:** 124¼ N. Parkview St., Los Angeles 26, Calif. (**A**)

Reiche, Ludwig P., Electrical Engineer, International Telemeter Corp. **Mail:** 1445 Miller Way, Hollywood 46, Calif. (**M**)

Rocha, Gustavo Humberto E., Head, Sound Service and Installation Dept., Casa Ehlers. **Mail:** Abraham Gonzalez #4, Mexico City, Mexico. **(A)**

Scherlis, William, Cameraman, 241 U. S. Grant Hotel, San Diego 15, Calif. **(A)**

Schulman, Marvin, Television Engineer, KPIX, Inc. **Mail:** 175 Buckingham Way, Apt. 1A, San Francisco 27, Calif. **(A)**

Simpson, Richard L., Motion Picture Projection Equipment Mechanic, Naval Photographic Center. **Mail:** 3716 Second St., S.E., Washington 20, D.C. **(A)**

Steel, Lt. Col. W. Arthur, Radio Engineer, Federal Electric Manufacturing Co. **Mail:** 4737 Grosvenor Ave., Montreal, P.Q., Canada. **(M)**

Theiss, Sylvester E., Technical Writer (Electronics), U.S. Government. **Mail:** 310 Audrey La., S.E., Washington 20, D.C. **(M)**

Tunnell, George W., Product Administration, RCA Broadcast Section. **Mail:** 222 W. Plumstead Ave., Lansdowne, Pa. **(M)**

Vaughan, Leslie D., Photographer, State Geological Survey, 404 Natural Resources Bldg., Urbana, Ill. **(A)**

Wallace, Charles A., Arizona State College. **Mail:** 600 E. Second, Roswell, N.M. **(S)**

Winkler, Ben, Sound Mixer, Radio Corporation of America. **Mail:** 11209 Emlita St., North Hollywood, Calif. **(A)**

Wolfe, Benjamin, Television Broadcast Engineer, WAAM-TV. **Mail:** 3513 Lucille Ave., Baltimore 15, Md. **(A)**

Worley, E. Max, Motion Picture Technician, Color Reproduction Co. **Mail:** 10552 Putney Rd., Los Angeles 64, Calif. **(A)**

CHANGES IN GRADE

Miller, William J., (A) to (M)
Roberts, Paul M., (S) to (A)

SMPTE Lapel Pins

The Society will have available for mailing after September 15, 1952, its gold and blue enamel lapel pin, with a screw back. The pin is a ½-in. reproduction of the Society symbol — the film, sprocket and television tube — which appears on the *Journal* cover.

The price of the pin is $4.00, including Federal Tax; in New York City, add 3% sales tax.

Meetings

72d Semiannual Convention of the SMPTE, Oct. 6-10, Hotel Statler, Washington, D. C.

Other Societies

International Society of Photogrammetry, Conference, Sept. 4–13, Hotel Shoreham, Washington, D.C.

American Standards Association, Third National Standardization Conference, Sept. 8–10, Museum of Science and Industry, Chicago, Ill.

Illuminating Engineering Society, National Technical Conference, Sept. 8–12, Edgewater Beach Hotel, Chicago, Ill.

Biological Photographic Association, Annual Meeting, Sept. 10–12, Hotel New Yorker, New York

National Electronics Conference, Annual Meeting, Sept. 29–Oct. 1, Sherman Hotel, Chicago, Ill.

Optical Society of America, Oct. 9–11, Hotel Statler, Boston, Mass.

American Institute of Electrical Engineers, Fall General Meeting, Oct. 13–17, New Orleans, La.

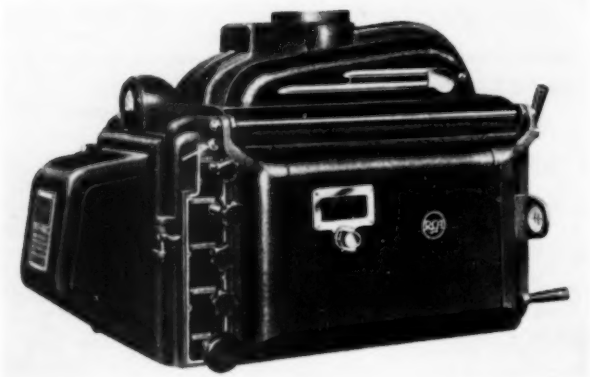
American Standards Association, Annual Meeting, Nov. 19, Waldorf-Astoria, New York

SMPTE Officers and Committees: The roster of Society Officers and the Committee Chairmen and Members were published in the April *Journal.*

New Products

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products.

This 5000-w Featherlite, weighing only 21 lb, is among the spotlights and other new studio lighting equipment described in a brochure by Century Lighting, Inc., 521 W. 43d St., New York 36, N.Y. Other equipment is: aluminum barn doors, mechanical dimmers, light lifts, hangers and mike boom.



The Hy-Arc is a new carbon-arc projection lamp for indoor and medium-size drive-in theaters that has been announced by the Theatre Equipment Section, RCA Victor Division of Radio Corporation of America, Camden, N.J. Features of the lamp are: a system of magnetic stabilization of the arc flame; water-cooled, nonrotating positive carbon; and a 15-in. high-speed reflector. The lamp's output is approximately 18,000 lm. It operates with a 9-mm × 20-in. high-intensity positive carbon and a $\frac{5}{16}$-in. × 9-in. negative carbon at currents from 70 to 90 amp.

Society of Motion Picture and Television Engineers

40 West 40th Street, New York 18, N. Y., Tel. LOngacre 5-0172
Boyce Nemec, *Executive Secretary*

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Oscar F. Neu, 330 W. 42 St., New York 18, N. Y.
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C. E. Heppberger, 231 N. Mill, Naperville, Ill.
Vaughn C. Shaner, 6706 Santa Monica Blvd., Hollywood, Calif.
E. M. Stifle, 342 Madison Ave., Rm. 626, New York 17, N. Y.

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J. E. Aiken, 116 N. Galveston St., Arlington, Va.
F. G. Albin, 241 So. Wetherly Dr., Beverly Hills, Calif.
G. W. Colburn, 164 N. Wacker Dr., Chicago 6, Ill.
E. W. D'Arcy, 7045 No. Osceola Ave., Chicago, Ill.
J. K. Hilliard, 2237 Mandeville Canyon Rd., Los Angeles 24, Calif.
A. G. Jensen, Bell Telephone Labs., Inc., 463 West St., N. Y. 14, N. Y.

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